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ILLUMINATING ENGINEERING SOCIETY.

At the annual meeting of the Illuminating Engineering Society, which was held in New York on Friday, January 10, the progress which had been made during the year was reviewed both by the outgoing president, Dr. C. H. Sharp, and the new president, Dr. Louis Bell, and a discussion on what were thought to be desirable lines of working took place. It is well, at this time, to call attention to the good work which has been accomplished during the past two years by the society, as this, in some quarters, does not seem to be realized.

As was pointed out by Dr. Bell, the aim of the society when it was organized was to advance the science and art of illumination by bringing together all those interested in artificial illumination. Certainly the record for the past two years shows how much good has been accomplished in this way. No other society could bring together electrical engineers, architects, fixture dealers, gas engineers, men interested in acetylene, and representatives of all the other industries having to do with artificial illumination. The various discussions which have taken place at the section meetings of the society are evidence of how much has been done in this direction. Until this society was organized there was no common meeting where these varied interests could come together and show to one another the ends toward which each is working. Previously there had been much sharp criticism by one interest of another, which criticism unfortunately was not infrequently based on misconceptions. This has largely given way to a disposition to understand what are the ideals of each branch of the art and to good-natured criticisms where there is an honest difference of opinion. Such a condition of affairs is a matter for rejoicing since the general state of the practice of artificial illumination is not what it should be, and until those interested in lighting methods can show a united front before the public not very much general improvement can be hoped for. It is in this way possibly that the greatest benefit of the Illuminating Engineering Society is to be secured.

In addition to this the work of members of the society in conducting original research and in publishing valuable papers giving the results of illuminating installations of many types has contributed largely to the literature of illumination and has put in the hands of those actively engaged in the study of problems in lighting, data which previously were not obtainable. In this field also the work of the society will be of the greatest help, particularly since we are now in a period in which new sources of light are being brought out about which not much

is generally known, and every one is seeking for information respecting their use.

The record of the last two years certainly justifies the organization of the society, and the good work which has been done, as well as the many opportunities before the members for further efforts, seem to indicate clearly that in the future it is destined to take a position even more influential than that which it now occupies. If this is to be done, of course it is the duty of every member of the society to put a shoulder to the wheel for the good of the general cause, and there should be no relaxation of effort until this country, which is already the most lighted, will also be recognized as the best lighted, in the world.

HOW DOES LIGHT AFFECT SELENIUM?

In the ELECTRICAL REVIEW of October 12 was described a new type of selenium cell devised by Mr. William J. Hammer in order to avoid the unreliability of selenium cells of the usual type. The most important feature of this cell was the enclosing of it in a glass or quartz tube which was then exhausted so as to remove all moisture from the tube. Cells constructed in this way, Mr. Hammer states, are far more regular in their behavior than the older type of cell in which the prepared layer of selenium is not protected from the atmosphere. According to Mr. Hammer it is the moisture which is absorbed by such cells which gives rise to their uncertainty of action. Chemical reactions may take place. The selenium layer under such conditions may react with the supporting or contact-making metals, and as its condition changes from day to day the cell acts as an indicator only, as its behavior one day may be far different from what it was the day before.

Referring to these cells in the issue of October 19, Mr. Hammer said that he does not believe there is any true photoelectric action of selenium; that is to say, when placed in circuit with a galvanometer, but no other source of current, no current can be caused to flow by exposing the cell to light. In the ordinary type of cell, however, in which the selenium contains more or less moisture, light may bring about chemical reactions which will give rise to currents, and it is probably this effect which has given rise to the so-called "photoelectric action." Cells protected from moisture, however, respond to the action of light, their resistances being changed in the well-known way.

In the issue of *Nature* (London), December 26, a communication from Mr. G. M. Minchin describes the effect which he found to take place when small selenium cells or "bridges" are enclosed in an exhausted glass tube. One of these cells was very sensitive and had a resistance before exposure to light of sixty-one million ohms in air. This was placed in a glass tube which was exhausted, when it was found that the resistance of the bridge had fallen to about sixty-one ohms at the end of twelve hours, and three days after exhaustion the resistance had dropped to 17.5 ohms. Moreover, when this bridge was exposed to light, it showed absolutely no effect, its sensitiveness having entirely disappeared. The same result was found with three other bridges, so that the author concludes that selenium, when placed in a vacuum, drops in resistance at least four million times, and also loses its sensitiveness to light.

These results do not seem in agreement with those of Mr. Hammer. However, there are some slight differences in the method of construction, which should be borne in mind. Mr. Hammer's cells are enclosed in a quartz tube, but this is merely to allow the ultra-violet rays of light to pass through and fall upon the selenium. Glass is opaque to these rays, and Mr. Minchin's cells were enclosed in glass. The latter also obtained a high degree of exhaustion, 0.01 millimetre, which perhaps is higher than that thought necessary by Mr. Hammer, whose idea was to abstract the moisture from the cell and to protect the selenium from any action of the atmosphere. This disagreement between the results of these two investigators raises the question of what really is the effect of light upon selenium. The action has usually been thought to be merely physical and the selenium is supposed to return to its original condition as soon as the light is cut off. If, however, no action takes place without air or moisture being present there may be some chemical change which produces a compound unstable except under the influence of light. The subject is one of considerable interest since the sensitiveness of selenium to light would be very useful for many purposes if the effect were known to be constant.

THE NEW SINGLE-PHASE MOTOR.

The new type of single-phase motor described elsewhere in this issue by Mr. E. F. Alexanderson marks another stage in the development of a single-phase alternating-current railway motor. In the new machine the desired starting and operating qualities are secured by a combination of the characteristics of the series-compensated motor with those of the repulsion motor, the latter features being depended upon for starting and the other for running. The most noteworthy features of the new motor are the use of a winding for compensating the armature reaction and for producing the repulsion effect, and the adoption of a fractional pitch winding which brings the conductors under the edges of the field poles at the moment of commutation. Although no characteristics of operation were given in the paper, it was said that in these respects the motor shows an excellent performance, it being approximately as good as the direct-current motor, and that it is as satisfactory for operating at twenty-five cycles as at fifteen, which should be an advantage if not obtained at too great cost. It is to be hoped that performance tests will be made public before long, for until this is done it is rather difficult to compare the new machine with those which are already in use. There are so many types of single-phase motors, either proposed or in actual use, that it seems evident some one type or types must be better than the others, and the sooner some definite decision, based on actual experience, can be made the more rapidly will the single-phase alternating-current system be assigned to its place in railway development.

HOW IS INTRINSIC BRILLIANCY HARMFUL?

At a recent meeting of the New York section of the Illuminating Engineering Society, Dr. H. H. Seabrook presented a paper discussing the effects of light upon the eye. In this he made some serious charges against modern illuminants. Three faults were found: one is the improper location of the lamps; another, placing them so that the eye is exposed to unshaded sources of light of high intrinsic brilliancy, and the third that such sources of light, that is to say, those of high intrinsic brilliancy, give rise to a greater proportion of short-wave-length rays—those which are most active chemically and usually designated as chemical rays—and that it is these rays which are most harmful to the eye.

With regard to the first two charges all will agree. In fact it was a general neglect of such matters and the ignorance exhibited on all sides by those responsible for lighting installations that led to the organization of the society before which Dr. Seabrook read his paper. These are matters which can not be corrected at once, but what can be done is being done, and already much improvement has taken place; these two features are no longer generally neglected. However, it may be questioned just how much they have had to do with the injurious effects upon the eye which are said to be so common to-day. It has not yet been shown that there are not other contributing causes which possibly might be more serious.

The third charge, that the greater proportion of short wave-lengths is a serious defect, can not be said to have been proved in Dr. Seabrook's paper. His line of argument seems to have been this: The new illuminants have a higher intrinsic brilliancy; an increase in temperature produces higher intrinsic brilliancy and a greater proportion of light toward the blue end of the spectrum; during the last fifty years or so the tendency has been toward lamps with high intrinsic brilliancy, and eye troubles are to-day commoner than they were previously; hence the trouble is due to these shorter wave-lengths. The deduction hardly seems justified as the argument is from one particular effect to another, and a relation between cause and effect has not been shown. Moreover, as one of the speakers pointed out, ordinary daylight is far more actinic than the light from any artificial source, but daylight is always taken as the standard toward which we should aspire.

When the actual source of light is small it necessarily must have a high intrinsic brilliancy if it is to radiate a large amount of light. It is often said that this high intrinsic brilliancy is injurious because it is dazzling. Dr. Seabrook says that the eye rests itself by constantly moving so as to bring a new portion of the retina into play. If the surface from which the light is radiated be large, it is not so easy to rest the eye in this way, since a larger portion of the retina is affected, and even though the dazzling effect be not so great, the eye may be wearied sooner if the quantity of light received be large; hence there may be as much damage done in this way, even though the effect be less painful at the start.

Another element entering into the problem seems to be generally overlooked, and that is the increasing use of the eye which is demanded of us under the conditions in which we live. That eye trouble is more frequent to-day than fifty years ago may be admitted, though it should be remembered that these ailments receive more attention now than they did before. To-day nearly every one is required to use his eyes constantly for reading and other work equally as trying. Work of this kind certainly has something to do with the failure of many eyes not naturally strong, but which, under less severe conditions, might have given no trouble. If, for example, every one in the middle of the seventeenth century had made a practice of keeping a diary we might have heard more about eye troubles. In the case of Samuel Pepys, they put a stop to his diary in ten years, in spite of the fact that he used nothing more injurious than a candle.

Leaving aside all questions of possible injury, lamps of high intrinsic brilliancy should be shaded because they thereby are rendered more effective. Hence, in a properly arranged lighting installation there should be no danger of the trouble Dr. Seabrook fears. But the man who is not familiar with all the factors entering into the problem may often not know which way to turn; for he finds, on the one hand, those who advocate large high-efficiency lamps; and on the other, he finds those who magnify the ills we are now heir to, and shudder to think that possibly there are some they know not of.

A CHARGE AGAINST GAS FIRES.

While firm believers in the advantages of electric lighting, we have always been ready to admit that gas for use as fuel could claim some consideration. It is clean and convenient, and, when properly safe-guarded, should not be dangerous. As a fuel for city purposes it promises to develop a larger field than it at present occupies. We have also been under the impression that gas is more widely used for heating purposes abroad. If this be true, and believing that the use of public utilities is regulated more strictly over there, the charge, made recently in London and noted in our English exchanges, comes as a surprise. It was said that the construction of certain of the gas fires is such that flames are thrown out beyond the limit of the combustion chamber; some times there are direct escapes for combustion products into the room; the adjustment of the gas and air supplies is frequently faulty; the stoves are arranged so as not to allow any ventilation, save through the gas fire itself; and these conditions tend to cause a circulation of the products of combustion which, in a living apartment, would be prejudicial to health.

Perhaps conditions on this side are somewhat better, but even here a flue for carrying off the products of combustion is generally omitted, and the stove is left to fill the room with carbon-dioxide, using up the oxygen which should be left for the occupants, even though, through faulty adjustment, it sets free nothing worse than an inert gas. If gas is to be the great boon to city life that its makers would have us believe, these little matters should receive attention. Why prevent a power station or factory from pouring out smoke and furnace gases into all outdoors when a little gas stove in an unventilated room may be far more prejudicial to comfort and health?

Third Annual Electrical Show at Chicago.

Auspicious Opening of Chicago's Yearly Electrical Feature at the Coliseum, January 13-25.

ONCE more the Electrical Trades Exposition Company has established a record in the inauguration of its third annual electrical show, at the Coliseum, Chicago, Ill., which it will be hard for other cities to beat. When the show, which will run until January 25, was officially opened at 7.30 P. M., January 13, the Coliseum presented a scene of beauty which defies description. Manager Homer E. Niesz was warmly congratulated upon the wonders performed under his direction by the architects, D. H. Burnham & Company. The exhibit spaces are grouped symmetrically and are absolutely uniform in appearance and treatment. The booths are arranged in two long centre rows running the length of the building, flanked on both sides by double rows of booths. At the intersection of each booth line along the dividing partitions are coniform pillars, surmounted by illuminated opalescent globes. At the division line of each booth is a shorter pillar surmounted by an opalescent globe, and the booths are railed in except where open gateways afford entrance to each booth.

The largest exhibit is that of the Commonwealth Edison Company, representing a nine-room residence, equipped with every known electrical device. The General Electric Company shows a mantel equipped with a luminous radiator mounted upon a metal backboard which fits a standard opening. This effect is attracting a great deal of attention. This company is also showing a very complete line of heating and cooking utensils, and along with its lighting features is showing the new forty and sixty-watt tungsten filament incandescent lamps.

The Western Electric Company has a lively exhibit, showing a number of machines in operation and exhibiting its well-known line of fan motors, insulating material, telephone apparatus, and other electrical specialties.

The National Electric Lamp Association is making a notable exhibit of 100-125-volt, multiple, 1.25-watts-per-candle tungsten lamps. This booth is decorated in such delicate colors as will bring out the importance of these lamps as units of illumination which preserve daylight color values. In demonstrating this "quality of light" a number of ingenious devices are shown, a tungsten lamp in comparison with a carbon-filament lamp demonstrating the difference in quality of these two electrical illuminants. One of the features is a "Newton's disc," showing how the composition of the spectrum is affected when under the two illuminants. Under the tungsten lamp the resultant color is very nearly white, while under the carbon-filament lamp the resultant color is a yellowish pink, showing where the carbon filament is lacking in the higher-temperature colors.

The huge electric sign is also attracting much attention. With this device, operated by the Electric Sign Writer Company, a sentence is assembled upon a keyboard and the whole message flashed at one time. The message unit consists of three tiers of units, each unit containing twenty-five incandescent lamps, and each tier consisting of twenty units.

Dr. Lee de Forest is personally conducting the demonstrations of his radio-telephone and wireless-telegraph systems, and despite the interference of the myriad of conductors and the hurly-burly of the music and the high-frequency effects, is convincing the unbelievers of the arrival of space communication without wires.

The Independent Telephone Exhibit, which is located principally in the Coliseum annex, is well supported, and is showing a fine line of apparatus. The largest exhibit is that of the Automatic Electric Company, showing a working demonstration of its system. The American Automatic Telephone Company is exhibiting its automatic system. Other telephone exhibitors are the American Electric Telephone Company, the Central Telephone Construction Company, the Chicago Telephone Supply Company, S. H. Couch Company, Dean Electric Company, Hensel Telephone Construction Company, International Telephone Construction Company, Kellogg Switchboard and Supply Company, which, however, has a fine exhibit in the main hall; Monarch Telephone Manufacturing Company, Sterling Electric Manufacturing Company, Stromberg-Carlson Company, Swedish-American Telephone Company, Vote-Berger Company.

Among other prominent exhibitors are the American Steel and Wire Company, American Electric Novelty and Manufacturing Company, American Electric Fuse Company, B. S. Barnard & Company, Benjamin Electric Manufacturing Company, Bristol Company, H. B. Camp Company, Central Electric Company, Chicago Fuse Wire and Manufacturing Company, Chicago Telephone Company, Chicago Pneumatic Tool Company, Frank B. Cook, Crane Company, Crescent Manufacturing Company, Joseph Dixon Crucible Company, Dossert & Company, Electric Appliance Company, Electric Storage Battery Company, A. O. Einstein, Federal Electric Company, Fort Wayne Electric Works, General Compressed Air and Vacuum Company, Jewell Electrical Instrument Company, H. W. Johns-Manville Company, J. Lang Electric Company, Lindstrom-Smith Company, Manhattan Electrical Supply Company, W. N. Matthews and Brother, Moon Vibrator Company, Monarch Electric and Wire Company, McRoy Clay Works, North Electric Company, North Shore Electric Company, Nungesser Electric Battery Company, F. W. Pardee, Phœnix Glass Company, John A. Roebling's Sons Company, Roth Brothers Company, Shelton Electric Company, Simplex Electric Heating Company, Solar Electric Company, Swedish Electric Vibrator Company, Universal Manufacturing Company, Vivax Storage Battery Company, Wagner Electric Manufacturing Company.

Throughout the term of the show special events are scheduled as follows: January 14, ladies' souvenir day; January 15, students' day; January 16, society day; January 17, meeting of the Chicago section of the Illuminating Engineering Society, in which the Northwestern Electrical Association joins; January 18, annual meeting of the Electrical Salesmen's Association; January 20, Rejuvenation of the Sons of Jove; January 21, 22, 23, annual convention of the International Independent Telephone Association.

On Monday evening, January 13, the opening night, a throng visited the exhibits manifesting the greatest interest in all forms of electrical apparatus. With the high character of the exhibits and the features of popular interest which the exposition management has provided, the third annual show, in its first week, bids fair to eclipse all previous shows in point of attendance and benefit to the exhibitors.

American Institute of Electrical Engineers.

The two hundred and twenty-fourth meeting of the American Institute of Electrical Engineers was held in the Engineering Societies Building on the evening of January 10. Two papers were presented at this meeting: one by W. S. Murray, electrical engineer of the New York, New Haven & Hartford Railroad, on "The New Haven System of Single-Phase Distribution with Special Reference to Sectionalization"; the other by E. F. Alexanderson, and entitled "A Single-Phase Railway Motor." Mr. Murray's paper discussed the question of choosing sections for the high-tension supply wires. The lengths of the sections on the New Haven were determined by local conditions. There are fourteen sections in twenty-one miles, no two having the same length. The advantages and disadvantages of adopting a small number in preference to a large number of sections were discussed somewhat in detail, and the factors entering into the operation of the system were described. The general conclusions are: that there should be feeders in addition to the trolley wires; the sections should not be less than one and one-half miles long; twenty-two feet is a general safe working height of trolley wire; the effect of smoke from locomotives upon the insulation is serious; the insulation should be carefully planned when passing under low bridges; time relays should be used for all feeders; section switches should be provided; signaling should be such as to prevent overlapping of sections by a single locomotive; and the signal towers should have reliable telephone communication.

Mr. Alexanderson's paper was next read. This will be found on other pages of this issue.

The discussion was opened by L. B. Stillwell, who said that the results of experiments with single-phase operation, such as described by Mr. Murray, were of the very greatest value, since they showed what actually took place, and not the designer's expectations. Referring to Mr. Alexanderson's paper, he said the new motor had one original feature of much value. The elimination of the idle resistance in the armature leads is important. He regretted that actual figures of the results of the operation were not given so as to enable any one to judge of the relative performance of this motor when compared with other single-phase motors.

A communication from B. G. Lamme, of the Westinghouse Electric and Manufacturing Company, was read by F. H. Shepard. In this Mr. Lamme regretted that the paper had not given the results of actual tests which will enable any one to compare the performance of the new motor with that of other types of single-phase motor. For this reason he had been obliged to make some assumptions in order to show how the performance of this motor might be expected to differ from that of the compensated-series machine. It is either necessary to limit the design of a motor to such proportions that the induction at the start can be kept down to such a low value that the short-circuit voltage is below the critical point, or to use preventive devices and thus raise the critical point and increase the output and improve the performance. Mr. Alexanderson prefers the first method, while Mr. Lamme thinks that better results are given by the second. He then compared the performance of the motor used on the New Haven locomotives with what should be that of a motor of this size modified according to the principles laid down in the paper. In starting a motor there are two currents to be considered; the working current, and the short-circuited current flowing through the coils under the brushes. The resistance leads are used to diminish this second current, making it approximately the same as the working current. When thus used they do not increase the losses in the motor, but since they reduce the short-circuited current largely they actually reduce the losses. In the New Haven motor the local or short-circuit current is about one and one-fourth times the normal working current, while the scheme outlined in the paper would produce excessive local currents and destructive sparking if the same starting torque were to be obtained. On the modified New Haven motor the short-circuit current would be about seven times the normal current. Even by reducing the induction to seventy per cent of its normal value, the short-circuit would still be five times the normal. At the same time the working current would be 2.86 times the normal. These figures should be compared with the actual New Haven motor, which takes a short-circuit current of 1.25 times normal and a working current of 1.65 times normal at the start. These figures also show the impossibility of improving commutation by using high-resistance brushes. This method of considering the performance of the motor shows clearly why fifteen cycles is more advantageous than twenty-five. The short-circuit current is a direct function of the frequency, and lowering the short-circuit voltage by a decrease in the frequency from twenty-five to fifteen will allow the induction to be increased sixty-six per cent. This figure must be modified, however, by the fact that the iron is worked at a high saturation in order to reduce the weight and dimensions of the motor.

W. B. Potter said that the information contained in Mr. Murray's paper was of much value. As yet no definite decision on the relative advantages of the overhead and the third-rail systems has been reached, but experience so far, he believes, is rather in favor of the third rail.

Referring to Mr. Alexanderson's paper he thought the essence of the improvement was in the better inherent commutation. It is desirable that a motor equipment should be able to slip the driving wheels, as the motors are less liable to injury if this be the limitation. The new motor will be able to slip the wheels even if geared for speeds as high as seventy-five miles an hour.

O. S. Lyford, Jr., said the object of sectionalizing the feeder system is to make the location of faults easy, but when a reliable system for locating faults is at hand great sectionalization is not necessary.

W. I. Slichter discussed the series-repulsion motor described by Mr. Alexanderson, explaining with some detail the behavior of this machine under starting and running conditions. In the new motor the compensating or inducing winding acts as a series transformer, and this arrangement gives practically ideal conditions for commutation at all speeds.

Dr. C. P. Steinmetz reviewed the early history of the series motor, referring to the work of David, Eickmeyer, Elihu Thomson and others. An important feature of Mr. Alexanderson's work was the investigations which had been made of the distribution of the magnetic flux. It is not sufficient merely to have the two magnetic components in the proper proportion, but the actual distribution of the flux is important.

Mr. Murray, before closing the discussion on his paper, said that it was impossible to compare the new type of motor and the single-phase compensated type without actual trial of the former, and that the New Haven road had already taken steps in this direction. He thought the elimination of the resistance leads a desirable feature. He is afraid that should a locomotive in which resistance leads were used become stalled, that these would be apt to burn out. He regretted

that some figures, showing the weights of these motors, had not been given.

Replying to the discussion upon his own paper, he did not agree with Mr. Potter that the third-rail is better than the overhead construction, since long-distance traction work must be considered, and for this the overhead construction with alternating-current transmission is the better. He agreed with Mr. Potter that the greater length of sections was desirable, and that from three to five miles would be good. Generally local conditions decide this. Trouble from locomotive blasts depositing soot on the insulators had been avoided by placing the main insulators on the side, instead of directly over the centre of the track.

Mr. Alexanderson, replying to the discussion upon his paper, said that in the case of a motor which can slip its wheels, the limitation of the output is the heating, and that the fifteen and twenty-five-cycle motors are in this respect equivalent in output. The motor referred to by Mr. Lamme was rated at 250 horse-power, while a motor of the type which he had described, having the same dimensions, has a rating of 280 horse-power continuous, at the same speed, and 350 horse-power for one hour. An 850-ton locomotive has been in service for six months, hauling trains of 400 tons, which slips the wheels at the start. According to Mr. Lamme an increase of twenty-five per cent in the flux might be secured by using resistance leads, but with the present design a much greater increase in the current is secured, and there is nothing to burn out. The power-factor does not depend upon the absolute value of the field excitation. It depends upon the relation between field excitation and armature reaction; therefore, if by abolishing the resistance leads the current density may be increased, the power-factor will not be affected. Consequently the output of the motor is raised. Motors of the type described in this paper have been in service for several months, though they have not that particular starting feature, it not having been practicable to use it at that time. For this reason the induction in the field used in starting is higher than that necessary in the modified type. As yet no burning of the commutator has been found. Practical experience with these motors has shown that the value of the flux in starting is equal to that allowable for running conditions in a series motor. A series motor starting with this flux would spark badly.

Kelvin Memorial Meeting.

Memorial exercises in honor of Lord Kelvin were held under the auspices of the American Institute of Electrical Engineers in the Engineering Societies Building, New York, on Sunday, January 12, at 3.30 P. M. The Institute and other scientific engineering societies were officially represented by delegates on the platform, and in spite of the inclement weather a large body assembled in the auditorium to honor the great man who recently passed away. The following is the impressive programme of the meeting:

MUSIC

Prayer and Address
REV. WM. T. MANNING, D.D.

Reading of Memorial Resolutions by Secretary.

Introductory Remarks.
PRESIDENT STOTT.

Lord Kelvin as a Churchman and Christian.
REV. WM. T. MANNING, D.D.

Lord Kelvin as an Electrical Engineer.
PROFESSOR ELIHU THOMSON.

MUSIC

Lord Kelvin as a Scientist.
PROFESSOR E. L. NICHOLS.

Lord Kelvin's Work in Submarine Telegraphy.
G. G. WARD.

MUSIC

Lord Kelvin in Naval Engineering.
REAR-ADMIRAL GEORGE W. MELVILLE, U.S.N.

Lord Kelvin and the American Institute of Electrical Engineers.
T. C. MARTIN.

BENEDICTION.
REV. WM. T. MANNING, D.D.

MUSIC

The resolutions of regret and condolence were read by Ralph W. Pope, secretary of the Institute, and were adopted by a rising vote and will be transmitted to Lady Kelvin. Secretary Pope also read a letter from George Westinghouse, expressing his regret at being unable to attend the services.

President Stott, in his introductory remarks, spoke of the great breadth of Lord Kelvin's work, which had been so wide that no one man felt competent to discuss it properly. For this reason a number of gentlemen had been asked to speak upon various sides of his life; these had all accepted.

Dr. Manning, in speaking of Lord Kelvin as a churchman and Christian, referred to his simplicity and sincerity and the charity which he had for all. He believed that freedom of thought led one to realize that science is not opposed to religion, but is a help; that there can be no conflict between the truth revealed in nature and that revealed in religion.

Professor Elihu Thomson referred to the affection with which Lord Kelvin was held by electrical engineers, and then related some of his most important achievements. A noteworthy feature of his work was the fact that his conceptions were complete and only details needed changes. Indeed, of much of his scientific work the same may be said. His designs of instruments or his theories need only slight modifications to be suitable for newer uses or for explaining recently discovered facts.

Professor E. L. Nichols said that it is difficult for us now to measure the full attainment of a contemporary, but the whole race declares that Lord Kelvin was the leading student of science in the world. He briefly outlined his scientific career; the difficulties under which his early work was done were pointed out and his connection with scientific progress from 1841 until his death was sketched. This was an era of scientific and industrial revolution in which Lord Kelvin held a leading part.

George Gray Ward paid a tribute to Lord Kelvin's work in designing and laying the first Atlantic cables. It was neglect of his advice that, in part, led to the failure of the first cable. Although he was the first to lay down the principles of submarine telegraphy, he never lost his interest in the work and always kept informed of the latest developments in this field.

Rear-Admiral George W. Melville, U. S. N., described Lord Kelvin's contributions to the art of navigation, particularly his improved marine compass and machine for deep-sea sounding. Admiral Melville was a personal friend of Lord Kelvin, and spoke of his great simplicity and patience, saying the world is happier that he has lived. Lord Kelvin's relation to the American Institute of Electrical Engineers, of which he was an honorary member, was briefly outlined by T. C. Martin, and the benediction was pronounced.

The following were the official representatives of the scientific and technical societies at the services:

American Association for the Advancement of Science, Professor Edward L. Nichols; American Electrochemical Society, Dr. E. F. Roeber and Professor Joseph W. Richards; American Institute of Mining Engineers, Dr. A. R. Ledoux; American Philosophical Society, Andrew Carnegie and Professor Michael I. Pupin; American Mathematical Society, Professor J. Howard Van Amringe, LL.D.; American Society of Civil Engineers, Charles Macdonald; American Society of Mechanical Engineers, Rear-Admiral George W. Melville, U. S. N.; American Street and Interurban Railway Association, Professor B. V. Swenson; Association of Edison Illuminating Companies, John W. Lieb, Jr.; Franklin Institute, T. Commerford Martin; Institution of Electrical Engineers (Great Britain), George G. Ward; Illuminating Engineering Society, Dr. C. H. Sharp and Dr. A. H. Elliott; National Electric Light Association, Dudley Farrand and W. W. Freeman; New York Electrical Society, Professor Albert F. Ganz and George H. Guy.

Management and Efficiency of the Designing Department, and Its Bearing Upon the First Cost and Economy in Operation of Steam-Electric Power Plants.

By Frank Koester.[1]

THE efficiency and economy in operation of a power plant are due primarily to the ability of the designer and his staff. The selection of the proper machinery and the general arrangement, as well as the details pertaining to the design of the plant, affect directly these conditions. Hence, in the design of an important power plant, the principal aim, besides low first-cost of the plant, should be efficiency and economy in operation. These, although of such great importance, are frequently overlooked or ignored even by the designer (the chief of the drafting department). It is the object of the writer, in presenting this article, to call attention to such matters as will be of interest to the designer and his staff, the consulting engineer in charge, or the contracting engineer, as the case may be, and particularly the capitalist whose money is to be spent.

In cases where a plant is to be provided for a railroad company, the designer is frequently in the employ of the company; contracts are sometimes made with a firm of consulting and contracting engineers to furnish the plan only; or in some instances, the entire plant, for a fixed sum. Sometimes a contract is made between capitalist and contracting engineer under which the latter is paid for the design and erection of the plant by a fixed percentage on the total actual cost of the plant. Another method is to pay the consulting engineer, for his service in designing and supervising the erection of the plant, a fixed fee plus a percentage on the total cost of the plant.

In the first form of contract the capitalist does not run the risk that the plant will be equipped too elaborately for the purpose for which it is intended. But the efficiency and economy of the plant, especially when designed by inexperienced power-plant engineers, may be questionable.

In the second instance the capitalist may run the risk that a too elaborate equipment may be provided in order to swell the profits of the contracting engineers. In this case a greater efficiency and economy in operation may be attained if the work is in the hands of designers of broad experience in this particular line.

In the third form of contract, where a fixed fee and percentage are paid the designer for the plans and supervision of the work, the percentage is necessarily small, and an increased cost of plant does not mean as great an increase in the total payment to the designer for his services.

Capitalists and corporations who let contracts for power plants should first make thorough investigations, not only as to the financial and business reputations of the consulting and contracting engineers, but should convince themselves as to the ability of their staffs, particularly of the designer in charge. This applies particularly to those engineering firms which are obliged, because of the lack of continuity of their commissions, or for other reasons, to make frequent changes in their staff. Many instances have occurred where, during the progress of the work of designing the plant, the designer in charge, or his principal assistants, for some reason or other leave the employ of the concern. The effect of such interruption in the progress of the work may readily be appreciated, and is usually due to lack of management or generalship on the part of the firm. Often, for this reason, the first-cost of the plant is excessively high and the efficiency and economy in operation do not come up to the expectations of the owner. This condition can not be altered after completion, and, therefore, proper investigations should have been made to secure capable designers before the design of the plant was undertaken. It will undoubtedly become the custom at no distant time, in letting contracts for complete plants, whether for the design only or for the design and erection, to require guarantees of the designers and contractors as to the efficiency and economy in operation of the complete plant.

Machinery is always sold under an efficiency guarantee which the manufacturer must live up to. It is the practice, particularly in connection with prime movers, to make such tests at the manufacturer's works, where ideal conditions for testing usually exist. Owing to this practice it is quite necessary, in order to secure the same degree of efficiency at the plant, that the assembling of the various machines (for instance, the condensers with their auxiliary machinery, as well as the manner of connecting same with the boilers and other apparatus), should be done in the proper manner. Cases frequently have arisen in which the manufacturer's guarantee of efficiency has not been secured in operation, due to improper design of the plant. The same type of apparatus has been found to operate at a high degree of efficiency in some plants, while in others the contrary has been experienced, owing to the fact that the various machines do not work in harmony. Since the proper efficiency was not secured, whether due to the manufacturer or the designer, it has sometimes occurred that certain machines or portions of the equipment had to be discarded and replaced by more efficient apparatus. In some cases, where the machines and auxiliary apparatus are so expensive that they can not be thrown out, their continued use, operating under conditions which are far from economical, means not only an exorbitant first cost, but also an unnecessary increase in operating expenses and depreciation, which is a continuous loss during the existence of the plant. For this reason many plants have been entirely abandoned after some years of service and have been replaced by entirely new plants, or new equipment.

From the few cases cited it will be readily seen that the first cost and the efficiency of the power plant depend largely upon the designer, and it is the writer's opinion that the designers of the plant must not only have a thorough theoretical and technical knowledge of the subject, but that their experience must have been broadened by actual work in the field, both in the erection and the operation of plants. The mere fact that an engineer has designed, or copied the design of a similar plant, does not signify that he is a thorough and capable power-plant designer.

Sub-contracts for the structure, as well as equipment, are frequently let to concerns from incomplete drawings and specifications, and as the contractors, naturally, aim to secure as great a profit as possible, they proceed with the work, and changes must be made later for which no

[1] Consulting engineer, New York.

provision has been made, and for these extras they will be able to secure good prices, all of which increases the first-cost of the plant. For instance, contracts for structural work are let on a per ton basis, and where drawings and specifications are incomplete the steel contractors have an excellent opportunity to increase the weight of the structure, and, furthermore, will secure higher prices per ton for all such additional material as has not been clearly specified.

The chief designer, particularly in the design of a large plant, can not always watch all details, many of which will affect the first cost as well as the efficiency of the plant. Therefore his staff of assistants must possess the required knowledge themselves properly to work out these details, and particularly if the knowledge and experience of the chief designer are limited. Consequently the profits to the firm of consulting engineers are reduced because of the higher salaries which must be paid to such assistants. It is not seldom that such chief designer, who is lacking in knowledge and experience, educates himself at the expense of his firm by employing such high-salaried assistants, some of whom might be easily dispensed with if his own experience had been broader.

As the scope of power-plant design is broad, embodying mechanical, electrical, structural, architectural and often civil engineering work, it is necessary, particularly in the design of large plants, to employ able assistant designers and draftsmen in each of these branches.

For instance, in designing a plant of 25,000-kilowatt capacity the staff may consist of the chief, one assistant (all-around man), who is familiar with the various branches of engineering required in connection with the plant, and four draftsmen (assistant designers), who are experienced in the four branches previously mentioned. The mechanical designer, who is always most familiar with the operation of steam-power plants, should arrange the general scheme and particularly the system of piping, as well as all foundations for machinery. The electrical designer, of course, will handle the wiring and switchboard equipment, and the structural man will have charge of the design of the structural work of the building, as well as such structural steel work as is necessary for supporting coal-handling machinery, boilers, etc. The architect is not usually called upon, as is evident from the character of many power plants, the architectural features having been sadly neglected. In plants of smaller capacity, the employment of a special architect is not justified, but an architect also qualified as a civil engineer might be employed to handle the architectural features and others, such as retaining walls, condenser-water tunnels, etc.

In order to bring about economy in the drawing room, for the less important work, such as tracing, lettering, etc., a few tracers must be employed, who may be shifted from one branch to another as necessity requires.

While checkers are necessary for every branch of designing, it is not feasible to employ one for each branch. It is customary, however, in the structural steel branch, to have a special checker in connection with the design of very large plants. In the design of such plants where the employment of a special checker for each branch is not warranted, the checking should be done by turning over the drawings to one of the other assistant designers, who will check it in conjunction with the original draftsman. This applies purely to the checking of dimensions, etc., as the work of designing has been carried on under the supervision of the principal designer and the all-around man. Any attempt to make it a part of the checker's duty to check the design would be a repetition of work, and the checker employed may not be competent to check the designs pertaining to each and every branch. It will, therefore, be seen that the employment of a general checker for checking the dimensions and the designs pertaining to all branches would not be justifiable, and a man with such general knowledge, including also thorough knowledge of every detail of the design, construction and operation of the plant, could not be found, because engineering, which now covers such an extensive field, has become highly specialized. To employ designers and able draftsmen for each individual branch, for a small, or even medium-sized plant, can not always be done, as the item of engineering expense would be too high in proportion to the cost of the plant. As the character of work done by a firm of consulting engineers covers not only power-plant design, but also general engineering work, and the chief designer frequently is not an expert in the particular work of power-plant design, an all-around power-plant engineer is required, to act in a supervising capacity in connection with these various branches, whose duty may also consist in checking all drawings which pertain to the general design. Having employed an all-around designer in this capacity the lower grade of draftsmen may be shifted from one line of work to another, thus not only cutting down the running expenses of the department, but also training these draftsmen for the duties of a general power-plant designer.

When capable draftsmen or assistant designers have an idea or scheme in connection with the work in their particular line, they should be encouraged in developing it and should not, as is too often the case, be overruled by the chief simply because he, as the head, has the mistaken idea that all good suggestions should emanate from him. If these subordinates receive such encouragement the efficiency of the department will be materially increased, and, naturally, the running expenses of the department will be accordingly decreased. Furthermore, if such ideas or schemes are good this may be seen at a glance by a capable chief, and the subordinate should be given an opportunity to develop them, which usually will not absorb much time, because of the interest which he takes in them. Credit should also be given the subordinate for such ideas, which should not be appropriated by the chief and put forth as his own scheme, nor should the chief throw the blame for all bad features of his own schemes upon his subordinates. This is one of the principal reasons why rising designers do not stick to the drawing-board, but seek opportunities elsewhere, and as a consequence, capable draftsmen and designers are scarce, such men devoting their energies to other branches where greater rewards are in store for them. For this very reason some of the universities discourage the students in the pursuit of occupation at the drawing-board.

Such lack of harmony and good-will among the members of the staff not only interferes with the success of the engineering firm, but may also affect the economy in operation of the power plant very seriously. It may also be far-reaching in its results, the chief often considering that his own selfish interests are better served if capable subordinates, who seem to be better qualified in some directions than he himself, are disposed of, the firm thereby losing efficient help which might better have been retained.

With proper management on the part of the executive head of the firm the conditions described would not exist in connection with its staff of engineers and assistants; and capitalists should be most careful in the selection of a firm of consulting engineers which is to take charge of their work, that such executive heads, and others concerned in the business management, have been chosen with proper regard to their ability to select and control the engineering staff, and that such managers do not owe their preferment to favoritism.

A SINGLE-PHASE RAILWAY MOTOR.[1]

BY E. F. ALEXANDERSON.

The various single-phase railway motors which have been developed during the past few years have been styled in general as either repulsion or as series motors.

The characteristics of the compensated series motor are well known; it comprises an armature, an exciting winding, and a compensating winding, usually all connected in series. One of the principal objections to this type of motor is the generation of an electromotive force in the coils of the armature which are short-circuited by brushes at the instant of commutation, due to the alternating character of the field. On this account this motor is limited to use on low terminal voltages.

The repulsion motor (invented by Elihu Thomson) has a short-circuited armature and a rotating flux. At speeds near synchronism the electromotive force of alternation in the short-circuited coils is counterbalanced by an electromotive force of rotation. The energy is introduced into the stationary winding and the motor can be wound for any desired voltage.

The most prominent types of single-phase railway motors which have found commercial application are:

1. The compensated repulsion motor (Latour, Winter-Eichberg). This motor has a short-circuited armature and an extra set of brushes for producing compensation, with a view to obtaining a higher power-factor.

2. The compensated series motor (Eickmeyer, Stanley, Lamme).

3. The compensated series motor with shunt-excited commutating poles (Milch, Richter). In this motor, a commutating field is produced locally by coils in the stator.

The motor to be discussed in this paper is neither a series nor a repulsion motor in the generally accepted sense, but embodies the best features of both. For lack of a better name it may be called a "series repulsion motor." The windings resemble those of a series motor, and the armature and stator are permanently connected in series. A general diagram of the motor is shown in Fig. 1. The terminal voltage of the series repulsion motor can be selected with greater liberty than in a series motor, but not so arbitrarily as in the case of a repulsion motor.

Its advantages over the straight compensated series motor are very marked. The commutation is so radically improved that resistance leads are unnecessary and it is feasible to build the motors in larger capacities.

In its performance it resembles the series motors with commutating poles, but offers several distinct advantages over the same. Instead of producing a commutating flux locally by coils on the stator, the conductors in the armature are located in such places where the desired flux will naturally exist. This arrangement simplifies the stator winding considerably. The compensating winding of the series motor is replaced by an inducing winding with twice as many turns, and the energy is introduced either in the stator alone or in the stator and rotor together. By this arrangement, as will be explained later, the starting torque is doubled for the same commutation and the same supply of current.

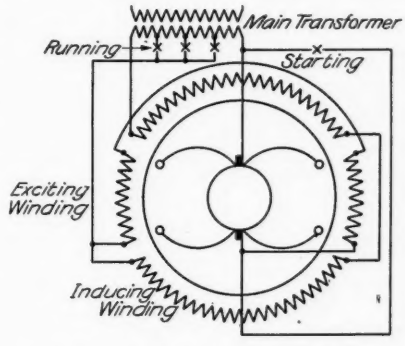


FIG. 1.—GENERAL DIAGRAM OF MOTOR.

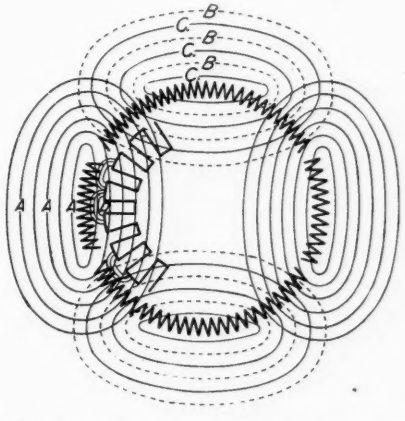


FIG. 2.—FIELD COMPONENTS INFLUENCING COMMUTATION.

In the compensated repulsion motor, the commutating field becomes too strong as soon as the speed appreciably exceeds synchronism, unless special arrangements are made to suppress this field locally. The motor under consideration is not limited by the synchronous speed, as the repulsion motor feature is reduced at the high speeds, and its action follows more closely the performance of a series motor; the number of poles can therefore be selected with the same liberty as in a series motor. This is of great importance for the motor characteristics, particularly in regard to weight and starting torque. Furthermore, no extra set of brushes, nor any series transformer, is required, which makes the motor equally well adapted for direct and alternating current. These being the most important general characteristics of the motor, there are a number of features which are of interest, particularly to the designer. Before entering into these details it will be necessary to give the general theory of the repulsion motor, together with the general theory of commutation.

The pure repulsion motor has a rotating field, and it appears plausible that commutation may be good in a rotating field, provided that the armature rotates at approximately the same speed as the field. However, a rotating field is not in itself a guarantee of good commutation.

When the field becomes elliptical in shape, it is difficult to grasp the phenomena of commutation unless the field is resolved into its components and expressed as functions of time and space. If this is done, the following field components influence the commutation, as illustrated in Fig. 2:

A is the "mail field," which is the torque-producing field, and corresponds to the field in a series motor.

B is the cross-field magnetized by an exciting current flowing in the armature, and serving to transfer the energy from rotor to stator. This field is in quadrature with the main field in time as well as space.

C is another cross-field magnetized by the difference between the ampere-turns of the armature and the inducing winding. This field is in phase with the main field.

D is the leakage flux around the commutated coils.

The conditions for perfect commutation are as follows:

1. The electromotive force of alternation of the main field should be neutralized by the electromotive force of rotation in the cross-field B.

2. The magnetomotive force of the stator should be larger than the armature reaction; the difference, which is the field designated C, should be large enough to overcome the voltage due to the leakage flux.

If these conditions are fulfilled the commutation is identical with that of a

[1] A paper presented at a meeting of the American Institute of Electrical Engineers, New York, January 10, 1908.

direct-current motor with commutating poles.

The first condition is found at synchronous speed in a repulsion motor, and theoretically in a series motor at infinite speed. In a series repulsion motor it can

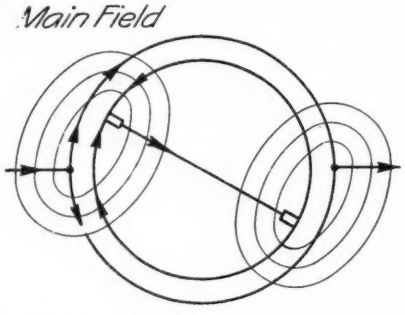


FIG. 3.—REPULSION MOTOR CHARACTERISTIC.

be obtained at any speed by varying the proportion between series and repulsion motor action.[1]

This, however, meets only one of the fundamental conditions necessary for good commutation; there are others which will affect commutation as much as will shifting the brushes of a direct-current motor from the right to the wrong side of the neutral.

The type of motor which is generally referred to as a repulsion motor is that with a continuous stator and rotor winding, and the brushes shifted in the direction of rotation as in Fig. 3.

If such a motor is used as a series motor with the stator and rotor connected in series, it is apparent from the diagram shown in Fig. 4 that that part of the windings which is included in the angle represented by the shift of the brushes

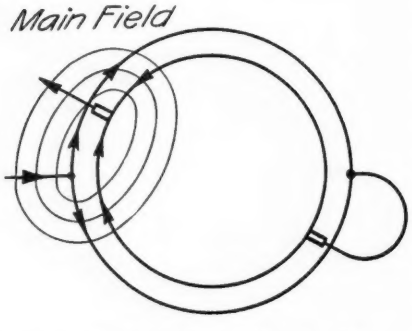


FIG. 4.—REPULSION MOTOR USED AS SERIES MOTOR.

constitutes the exciting coils, and the lines of force are distributed as shown on the diagram. The brushes are shifted in the direction of rotation and are located on the edge of the active field. It is well known in direct-current practice that the brushes of a motor ought to have a backward shift, if any, but never a forward shift; and it is therefore obvious, considering the direct-current features, that this motor can not commutate well. In the repulsion motor the armature currents are induced by the transformer action, but the distribution of the currents is substantially the same as described above for the series motor. This difficulty has led to the design of an armature winding as shown in Fig. 5, by which the electromotive force due to the cutting of the active flux is eliminated. The magnetization is produced by a separate stator winding located symmetrically with respect to the brushes. This gives a distribution of the fields as shown in Fig. 5. The armature conductors under commutation are located on the edge of the field flux, so that both sides of the coil are under an equal flux of the same polarity.

There is another way of looking at this

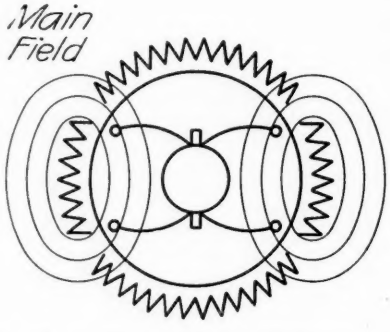


FIG. 5.—SPECIAL ARMATURE WINDING AS AFFECTING DISTRIBUTION OF THE FIELDS.

phenomenon which leads to the same result: The winding of the repulsion motor can be separated into an exciting winding and an inducing winding; in this case the brushes are located in the neutral of the stator winding. The armature is the short-circuited secondary of the inducing winding and must consequently have substantially the same total number of ampere-turns. The two fields that are excited by the stator and rotor individually are shown in Fig. 6 (*a*). The rotor field is peaked and stator field is flat-topped, giving a resulting field as shown by the cross-section part of the diagram. Consequently, there is a resulting peaked field opposite to the brushes where the conductors under commutation are located. This field is excited by the armature and has all the detrimental effects of armature reaction. Fig. 6 (*b*) shows how this is overcome by a fractional pitch winding on the armature. It also shows why only one definite winding pitch gives the correct result, whereas a greater or less ratio gives a field in the wrong direction.

The correct combination in Fig. 6 (*b*) shows the rotor flux slightly lower than the stator flux, whereas if there were no leakage the currents and corresponding

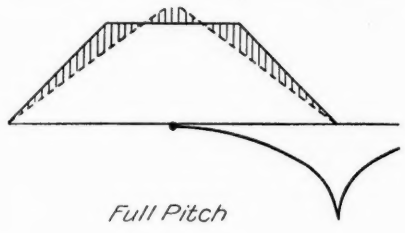


FIG. 6A.

fluxes would be equal; but actually, the primary is a little higher, due to the leakage. The difference between these two fluxes acts as a commutating field; but, on the other hand, the higher the leakage, the higher will be the commutating flux needed to overcome the leakage. If, however, the armature is short-circuited through a reactive coil, the resulting flux is increased without introducing leakage in the armature. Since the field of the

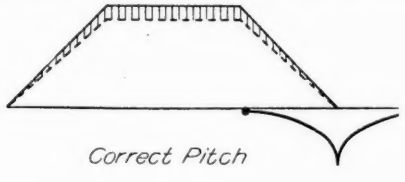


FIG. 6B.

motor is a reactive coil itself that must be excited, a convenient way of introducing reactance into the motor armature is to use the motor field or a part thereof for this purpose. That it is beneficial for the commutation of a repulsion motor to introduce the field in the armature instead of the stator circuit was experimentally demonstrated long ago by E. W. Rice, Jr. The reason for the improvement as ex-

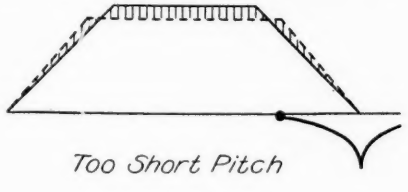


FIG. 6C.

plained above, is that the reactance of the field changes the ratio between stator and rotor ampere-turns so as substantially to offset the wrong distribution of currents with the full-pitched winding. The fact of the reactive coil being the field winding is in this respect immaterial, and it has been proved that the field of a similar ma-

[1] Diagrams have been shown by Milch and Latour with a voltage impressed on the armature circuit in order to meet this condition.

chine introduced in the same place gives the same result.

The above discussion demonstrates how the two fundamental conditions for good commutation can be fulfilled in a series repulsion motor at any speed without the aid of commutating poles. Instead of creating a commutating flux artificially in a place where the commutated conductors happen to be, the conductors are located in a place where the correct flux will naturally exist. By controlling the value as well as the phase of the different fluxes as described, perfect commutation can be obtained at any speed.

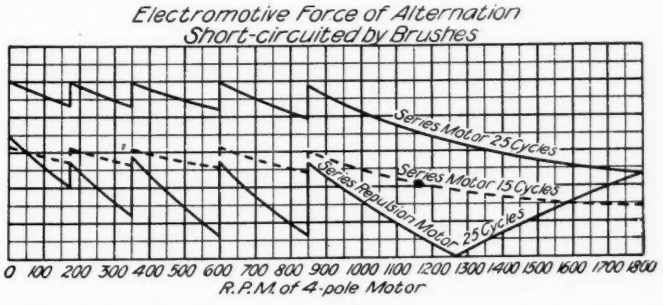

Electromotive Force of Alternation
Short-circuited by Brushes
Series Motor 25 Cycles
Series Motor 15 Cycles
Series Repulsion Motor 25 Cycles
0 100 200 300 400 500 600 700 800 900 1000 1100 1200 1300 1400 1500 1600 1700 1800
R.P.M. of 4-pole Motor

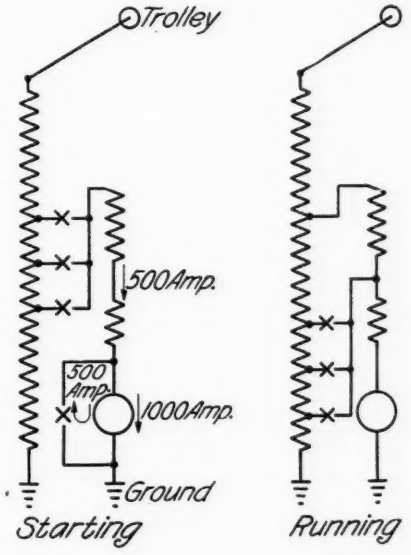
FIG. 7.—ALTERNATING VOLTAGES IN SHORT-CIRCUITED COILS OF SERIES REPULSION MOTOR.

Fig. 7 gives a comparative diagram of the alternating voltages in the short-circuited coils of a series repulsion motor for twenty-five cycles and for the same motor when used as a series motor for fifteen and twenty-five cycles. The improvement introduced by the fractional-pitch armature winding is a separate matter and is of the same character as the change from an ordinary direct-current machine to a commutating-pole machine.

STARTING.

The starting of a single-phase motor is materially handicapped by the fact that the alternating nature of the main field sets up currents in the armature coils which are short-circuited by the brushes. This same difficulty is experienced in all known types of single-phase commutator motors. Although the principle involved is the same in the motor under consideration, the practical result gained by the arrangement employed is a starting torque twice as high as would be possible in a corresponding series motor for the same commutation and the same supply of current.

This double starting torque is obtained by winding the stator with twice as many turns as the armature. The motor starts as a repulsion motor with the armature short-circuited as shown in Fig. 8. The current as it enters the stator has only half the strength of that in the rotor, owing to the ratio of stator to rotor turns. The short-circuiting switch of the rotor carries only half as much current as the rotor itself, because the current in the short-circuited connection is only the difference between the stator and the rotor currents. The inducing winding, the field, and the armature are connected permanently in series; but with the connections shown, the field is in series with the stator circuit at starting and with the rotor circuit when running. In starting, the rotor carries twice as much current as when running, in order to give the same field strength—in this manner doubling the starting torque. The sparking at starting is quite insignificant up to a certain value of the voltage short-circuited by a brush, but beyond this point the commutation rapidly becomes bad. This critical value is about the same as that which gives a reasonably good commutation in running. For a pure compensated series motor, therefore, the same remedy must be looked for in running as in starting conditions, and the natural solution is to design the motor for a low voltage or to use resistance solution.



FIGS. 8 AND 9.—METHOD OF CONTROL.

In ordinary series motor equipments, the difficulty arises that a higher starting torque is usually required than the full-load running torque, and if the short-circuited voltage is permissible in running, it will get too high at starting. A starting torque of twice full load (one-hour rating) torque is, however, usually more than enough, and therefore the short-circuited voltages can be kept below the critical point, while the torque is increased above normal. It is, however, not only the critical value of the voltage, but also the time that such a voltage is maintained that determines what is permissible. In this respect any repulsion motor has a great advantage, because the sparking disappears altogether as soon as the armature has reached an appreciable speed. Furthermore, a voltage could be allowed in starting with double torque which would not be permissible with normal running torque, on account of the short time-element of the starting condition.

The general principle which has been discussed for regulating the field in starting an alternating-current motor can be applied in different ways; it was first employed by Eichberg, who used a variable series transformer in the field circuit. Particular attention may, however, be called to the simplicity of the arrangement described here, where the same result is accomplished through the inherent characteristics of the motor without the use of any additional apparatus. The same principle can be applied to series motors by the use of a series transformer or some suitable controlling device, but it involves the disadvantage of doubling the current which is to be supplied to the motor through the control system, whereas when starting as a repulsion motor, increased torque is gained by a local current superimposed on the main current by induction.

Control—In regard to the practical application of the system, it may be mentioned that several four-motor equipments for alternating and direct current have been in operation for some time. The alternating-current control equipment has a total of seven contactors and a reversing switch. This gives four points on the controller, which seems quite satisfactory for motor-car operation, though any number of steps can be added to take care of locomotive operating conditions.

The preferred method of control is the one shown in Figs. 8 and 9. In starting, the armature is short-circuited and the full secondary voltage of the transformer is impressed upon the inducing and exciting windings. The current flowing

through the stator continues through the armature, but due to the ratio of turns of inducing winding and armature winding, an additional current of equal strength to the stator current flows through the local circuit of the armature and the short-circuited connection. In the running connection, part of the power is introduced in the stator and part in the rotor, and the field-winding carries the same current as the armature—that is, twice the stator current—thus giving a relatively greater field strength than in the starting condition, just as it would be produced by a series-multiple connection of the field-winding.

Although the total potential impressed upon the stator and rotor is the same for starting and running, the result of changing the connection so as to transfer the energy input from the stator to the rotor has the effect of increasing the resulting voltage of the motor. This is due to the ratio of transformation between stator and rotor. In this manner a higher speed is obtained by impressing a higher resulting voltage, and the same change of connections makes the motor adapted for a higher speed by changing the ratio of series and repulsion motor action.

Power-factor—The only motor that has an inherent claim on unity power-factor is the direct-current motor. In every alternating-current motor a certain amount of wattless volt-amperes is consumed in magnetizing the field, and in leakage, so that the maximum torque is limited to a lower value than it is with the direct-current motors. An alternating-current motor with inherently good power-factor is one with high overload capacity, and this must be due to a comparatively small proportion of volt-amperes being consumed for magnetization. There are, however, artificial methods of bringing the power-factor of the alternating-current motor up to unity. For example, an induction motor can be shunted by a condenser, and a commutator motor can be arranged so as to generate a certain amount of volt-amperes in order to supply its own magnetization. Any arrangement for this purpose does not improve the torque characteristics of the motor, any more than a condenser improves the performance of the induction motor; it improves only the phase displacement of the supplied current. The effect on the system can be corrected equally well by other machines on the same system adjusted for leading current.

The alternating-current series motor has a higher power-factor than the three-phase induction motor with the same magnetic structure, because the series motor generates a certain amount of volt-amperes. The power-factor of a series alternating-current motor can be increased to unity by displacing the phase of the field current; for instance, by shunting the field with a non-inductive resistance. In fact, the higher power-factor is due to internal shunt currents, the core-loss as well as the short-circuit current in the brushes having the character of shunts on the field winding. Eliminating the core-loss as well as the short-circuit currents in the brushes would, therefore, evidently improve the motor itself, although it would lower the power-factor.

The following is a short statement of the functions of the different fluxes in a repulsion motor. The motor is understood to be designed, as described before, with a definite degree of fractional pitch and the brushes in the neutral position.

Power-factor of the Repulsion Motor with Field Winding in Stator Circuit—In a repulsion motor the current passing through the inducing winding produces a corresponding current in the armature. By the rotation of the armature in the main field an electromotive force is generated in the armature, which causes a magnetizing current to flow which is superimposed upon the main current, and it is this magnetizing current that causes the voltage to be transformed back to the primary. In other words, the current is transformed from the stator to the rotor and the electromotive force generated in the rotor is transformed back to the stator. One flux is needed to transform current and another flux to transform the voltage. These two fluxes are out of phase. The voltage flux is generated in the armature by rotation and does not consume any volt-amperes from the line. The main flux as well as the current flux and the leakage flux consume volt-amperes.

Power-factor of the Repulsion Motor with Field in Armature Circuit—The theory of this motor is the same as above, except that it takes more flux to transform the current because the armature circuit includes the impedance of the field. Why this increased flux is good for the commutation has been shown above. The same magnetizing current for the voltage flux as described above flows through the armature, and in this case through the field also. This magnetizing current displaces the phase of the main field, and consequently the electromotive force of the machine. The displacement tends to lower the power-factor and the result is the same as if the volt-amperes of the voltage flux had been supplied from the line. In other words, the motor has the same inherent power-factor as a single-phase induction motor.

A series repulsion motor as developed for railway service has only one-third to one-quarter repulsion motor action, this being the proportion that gives sparkless commutation from synchonous to double synchronous speed. The lowering of the power-factor due to magnetizing current is therefore very slight, and with the greater liberty in design that is gained in the series repulsion motor, the power-factor is practically the same as in a series motor.

The analysis of the phase displacement also indicates how the power-factor can be corrected by shifting back the phase of the field current. This can be done in the series repulsion motor, as well as in the series motor, by shunting the field by a resistance according to the suggestion of Dr. A. S. McAllister. It can also be done, as has been experimentally demonstrated, by a slight degree of separate excitation of the field derived from the main transformer or from the stator coils. However, any raising or lowering of the power-factor of phase displacement does not affect the tractive effort or heating of the motor; it only changes the voltage that has to be applied in order to overcome the inductive drop. As soon as any artificial method of raising the power-factor involves any complication—for instance, another set of brushes on the commutator—it will probably prove preferable to improve the constants of the system by using synchronous machines wherever power is used for other purposes.

Resistance Leads—The use of resistance leads has been found to be unnecessary in motors of the type described. Certain motors which have been operated for a considerable time as series motors, and then rewound so as to embody the features described in this paper, have shown an increased life of brushes and commutator up to the standard of good direct-current practice. The improvement in commutation was so great that it was possible at the same time to increase the thickness of the brush and the output of the motor.

Selection of Frequency—In regard to choice of frequency, the series repulsion motor again gives greater liberty. Whereas the starting torque can be doubled on either fifteen or twenty-five cycles, it may be mentioned that a series motor which was almost inoperative at a certain load at twenty-five cycles, after rewinding, as de-

scribed, was tested as a series repulsion motor, and found to give excellent commutation at forty cycles, at the same load. It can therefore be said in general that twenty-five cycles is entirely satisfactory for all geared motor work; it is preferable in that the combination of motor and transformer weighs less at twenty-five than at fifteen cycles.

Economy of Material—The motor described can be built in larger capacities than the series motor. The principal reason for this is the inherently good commutation and increased starting torque which make resistance leads unnecessary, thereby eliminating the heat generated by the resistance leads, and also gaining space in the slots, which can be used for copper. Furthermore, it is possible to increase the flux per pole without impairing the commutation.

The fractional pitch winding, which is used primarily for the sake of commutation, is also advantageous from the point of view of economy of material. The saving extends not only to the end-connections, as is the case with the fractional-pitch induction motors, but also to the stator winding, inasmuch as only the active armature conductors, or only about eighty per cent of the total pitch as effective compensated for; whereas, with the full-pitch armature, the entire winding must be compensated for. In neither case is it possible to utilize more than about eighty per cent of the total pitch as effective pole arc, because of the space occupied by the field-winding. This principle is applicable to any compensated machine of the Deri type for alternating or direct current, except when the commutating pole is used.

The fact that the number of poles in the series repulsion motor can be selected without regard to the synchronous speed is an important consideration. The tractive effort of an alternating-current motor referred to the periphery of the armature is directly proportional to the number of poles employed, provided that the same flux per pole is used and the same current density in amperes per inch of circumference. The allowable flux per pole depends upon the type of winding and thickness of brush, but the same limitations exist for all known types of motors. The formula for tractive effort given below is deduced from the fundamental formulas for commutator machines, but it is of special interest because it brings all motors to the same basis and shows the advantage of liberty in selecting the number of poles.

The tractive effort in kilogrammes at armature periphery = amperes per cm. $\times \frac{\text{flux}}{\sqrt{2}} \times$ number of poles $\times \frac{1}{9.8}$.

The only constant in this formula is the acceleration of gravity, 9.8, in the metric system.

Tractive effort in pounds at armature periphery = amperes per inch $\times \frac{\text{flux}}{\sqrt{2}}$ $\times$ poles $\times$ 0.089.

This formula also indicates which method can be considered to obtain as high a starting torque as possible with a given number of poles. The starting torque depends only upon the flux per pole and the current density. The permissible flux can be slightly increased by the use of resistance leads. A considerably larger increase can, however, be obtained by raising the current density momentarily without changing the flux. This is the method that has been adopted in the motor described.

At first glance it may appear that this method would lead to an overheating of the winding. This, however, is not the case. In a motor of this type the I^2R losses are of about the same magnitude as the losses due to the field and the rotation. The total losses of the motor are therefore not increased by the square of the current, but more nearly in proportion to the current. Furthermore, when an increased starting torque and increased acceleration are obtained by increased current, the duration of the excessive current will be so much shorter, with the result that a train can be brought up to a certain speed with only slightly higher heating, if this is done at a higher rate of acceleration and with the use of an increased current.

In summing up the preceding the particular advantages of the motor described may be claimed to be:

1. Good commutation at all speeds without the use of resistance leads.

2. Larger capacities possible than with the series motor.

3. High tractive effort possible, due to the liberty of selecting the number of poles.

4. Increased starting torque, possible because of the inherent ratio of winding turns, without supplying an increased current from the main transformer.

5. Simplicity of Construction — The stator is the same as in the series motor, in fact easier to construct due to the greater liberty of placing the field-winding in slots. The armature is constructed according to standard direct-current practice with the conductors soldered into the commutator bars.

6. Equally well applicable to direct and alternating current.

Concerning Synthetic Rubber.

In this discussion of the prospects for securing a synthetic or artificial rubber, the view is taken that but little has been accomplished as yet in this direction. Producers of so-called "synthetic rubber" may be grouped into three classes. The first makes something of the oil-substitute type. It may be used in connection with india-rubber, but has no particular value alone. The second begins with crude rubber, fine Pará preferably, and doctors it with something like oil of wintergreen to disguise it thoroughly, producing what is then called synthetic rubber. The third class embraces honest, usually aged, chemists who buy most of the ingredients for secret formulas, upset all rules governing chemical reactions and think they produce "synthetic rubber." It is not said that synthetic rubber will never be made, but its first cost, should it be made, will probably for years make it only a plaything of the laboratory.—*India Rubber World (New York), January* 1.

New Haven Road to Build Portchester Electric Line.

At the request of the Board of Estimate and Apportionment for the city of New York, President Charles E. Mellen, of the New York, New Haven & Hartford Railroad, admitted the absorption of the New York & Portchester and the New York, Westchester & Boston Railroad companies, and declared that it was the intention of his company to build a line to Portchester for high-speed electric service under the merged franchises of the two companies. The New York, New Haven & Hartford Railroad owns the Millbrook Company. The Millbrook Company owns all of the shares of the New York & Portchester Company, which practically owns the New York, Westchester & Boston Railroad.

Civil Service Examinations for New York State and County Positions.

The New York State Civil Service Commission will hold examinations on February 1 for the following positions: Bridge designer, $1,500 to $2,100; civil engineering draftsman, $4 to $5 a day; leveler, $4.50 to $5 a day; steam engineer, Monroe county service, $900.

The last day for filing applications for these examinations is January 25. Full information and application forms may be obtained from Charles S. Fowler, chief examiner, Albany, N. Y.

THE PURIFICATION OF FEED-WATER.

BY CHARLES L. HUBBARD.

(Concluded.)

For large plants, or where space is valuable, special filters of a more compact form are more generally used. A filter of this type is shown in Fig. 3.

The filtering portion of the apparatus occupies the lower or main chamber and consists of a corrugated cylinder built up of sections held together by four long bolts extending through the cylinder near its axis. The sections or discs are of bronze and are perforated with a large number of small holes.

A long bag of Turkish toweling is passed over the cylinder and then drawn down between the sections by cords, as shown in the illustration. This manifolding or fluting of the toweling gives a large area for the water to pass through, which ranges from 250 to 1,000 times that of the feed-pipe and thus causes a low velocity of flow through it. Water enters through valve A, as shown by the arrows, passing through the filtering material and out by way of valve B to the boiler. The separated matter accumulates on the outer side of the filter and gradually increases the resistance to flow, this resistance being indicated by pressure gauges connecting with the two sides of the filter. When this difference reaches two or three pounds the filter may be cleaned by reversing the flow of water or by renewing the toweling. To provide for the removal of the cylinder when in use, the valve A is fitted with a face on each side of its disc which may be closed on either an upper or a lower seat. With the disc down and the valve B closed, the water is passed around the filter. The same arrangement of valves allows for the reversal of flow. This is done by closing A and opening the drain-cock at the lower part of the filter and valve B.

There are various other filters in use, but space does not allow a description of their construction.

The skimming process may take place either in a chamber outside the boiler or in the boiler itself. Fig. 4 shows a section through an external arrangement which is placed between the feed-pump and boiler, and is designed especially for the removal of oil and other impurities which may be mixed with it. The general construction is evident from the illustration. Water enters through the pipe A and passes alternately over and under a number of vertical partitions which do not extend quite to the surface of the water in the chamber, this being kept at a constant level by the use of a ball-cock. As the surface of the water is kept practically quiet, the oil, etc., rise in the form of a scum and are blown off from the pan E through a valve and pipe not shown.

Fig. 5 shows an automatic arrangement for skimming the surface of the water in a tubular boiler. A funnel, supported by floats, rests on the surface with the opening toward the front. As the circulation in a boiler of this type is toward the rear at the surface of the water, the scum is carried into the funnel and by means of an external pipe into a separator or settling tank. The circulation through the connecting pipes is indicated by the arrows and is maintained by the difference in temperature of the water in the upper and lower pipe. The settling tank contains an interior chamber, open at the bottom and closed at the top. The scum is delivered above this and the pure water is drawn off from the top of the interior chamber. Suitable blow-off connections are provided for clearing the outer cylinder as may be required.

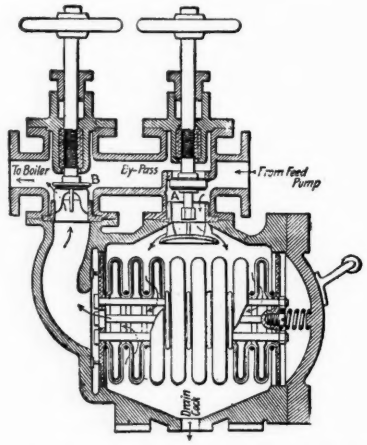


FIG. 3.—SPECIAL FILTER FOR LARGE PLANTS.

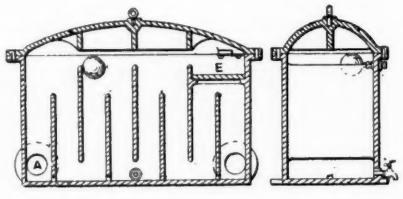


FIG. 4.—FOR REMOVING OIL AND OTHER IMPURITIES FROM FEED-WATER.

PURIFICATION BY CHEMICAL MEANS.

This process is employed for the elimination of the carbonates, sulphates, nitrates and chlorides of lime and magnesia, and also in special cases where the water contains certain acids, etc.

As in the case of other processes of purification, a careful analysis of the water supply should first be obtained and the method of treatment governed accordingly.

The usual methods by which water is purified chemically are three in number and are known as the lime process, the soda process and a combined lime and soda process. The particular process that shall be employed depends altogether upon the impurities to be removed, as stated above.

Let us first take up the removal of the carbonates of lime and magnesia. We have seen how the soluble bicarbonates are changed to insoluble carbonates by driving off the carbonic acid through heating the water. In the present method the same result is secured by chemical action. The lime process may be used for this purpose, and its action is as follows: When limestone (carbonate of lime) is heated the carbonic-acid gas which it contains is driven off, leaving quicklime, which is a combination of lime and oxygen. Quicklime, dissolved in water, forms hydrate of lime, or what is commonly known as lime-water, and has a great affinity for carbonic acid. When lime-water is added to feed-water containing bicarbonate of lime the carbonic-acid gas leaves the bicarbonate for the lime-water, thus changing the bicarbonate into carbonate, which, as we have already seen, is insoluble and is precipitated to the bottom of the tank in which the action takes place. The lime-water which is put in forms with the carbonic-acid gas more of the carbonate of lime, which is also precipitated. It is important that no more lime-water should be added than will just take up the carbonic acid in the bicarbonate to form the carbonate, for if an excess should be carried over and again meets water containing carbonic acid it will combine and form carbonate of lime in the boilers.

Caustic soda may be used for the same purpose as lime-water if desired. In this case the bicarbonate of lime is changed to the carbonate and precipitated, and the caustic soda to carbonate of soda, which is soluble at all temperatures.

When this process is used the boilers should be blown off occasionally to prevent the soda solution from becoming too concentrated, as it is likely to cause foaming.

The lime-water is much cheaper and for this reason has a great advantage over caustic soda in large plants.

Bicarbonate of magnesium is acted

upon in practically the same manner as bicarbonate of lime and all of the foregoing remarks apply equally well to the magnesium salt.

Let us next consider the removal of the sulphates of lime and magnesia by the soda process. The chemical used for this purpose in nearly all treating plants is soda ash (carbonate of soda). When this is added to water containing sulphate of lime the resulting chemical action is the formation of carbonate of lime, which is precipitated, and sulphate of soda, which is soluble at all temperatures. Here, as in the case of caustic soda, the water becomes strongly alkaline by the accumulation of soda and must be blown out frequently to prevent foaming.

If carbonic acid is present in excess when the above treatment is applied, it prevents the precipitation of the carbonate of lime, because the excess of carbonic acid unites with the carbonate of lime, forming the bicarbonate of lime, which is soluble. Conditions of this kind are cared for by the combined lime and soda process described later.

The reaction between the sulphate of lime and soda ash takes place slowly unless the water is heated, consequently caustic soda is sometimes used instead. Caustic soda produces sufficiently good results without the use of heat, but is much more expensive. The reaction is similar to that of soda ash.

Sulphate of magnesia alone does not form a scale, but if the bicarbonate of lime is present the addition of lime-water to precipitate the carbonate causes the sulphate of magnesia to form the sulphate of lime, which in turn must be removed by the use of soda.

It is evident from the above discussion that the combined lime and soda process is necessary when there is more than sufficient carbonic acid present to produce the precipitation of the sulphate of lime by the soda, and also when both the carbonates and sulphates of lime and magnesia are present.

The method of applying this treatment can best be shown by a brief description of a typical purifying plant.

There are various systems of this kind in use working upon practically the same principle, although quite different in detail. The one shown is chosen because it illustrates in a simple manner the various stages of the process.

In Fig. 6 A is a tank containing lime-water kept from settling by means of a by-pass from the solution pump, which keeps it in a constant state of agitation. The solution pump shown above the tank is a small single-acting boiler feed-pump especially constructed for handling chemicals, and its use is to feed the lime-water into the water to be purified. The

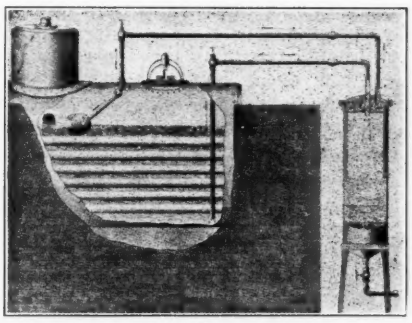


FIG. 5.—AUTOMATIC SKIMMING APPARATUS.

feed-water, which should be at a temperature of 175 degrees or more, enters C as shown by the arrow, and the pressure is indicated by the gauge D. The lime-water is supplied to the feed-water just as it enters C and is thoroughly mixed with it by means of an arrangement of interior piping not shown in the illustration. The first effect is to neutralize any free acids which may be present in the water. The next step is a precipitation of the car-

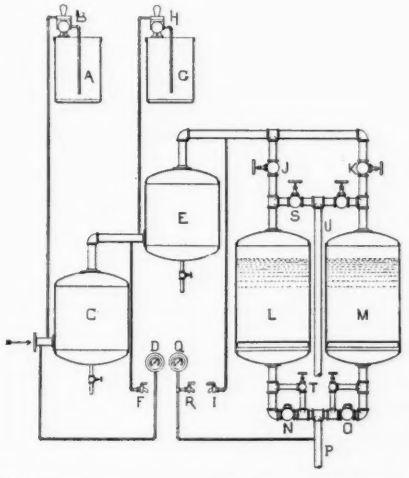


FIG. 6.—SAMPLING AND TESTING APPARATUS.

bonates of lime and magnesia by the action already described. Iron is also held in solution by an excess of carbonic acid and is precipitated by lime-water in the same manner as the bicarbonates of lime and magnesia.

These various precipitates settle in the bottom of C and may be blown off at intervals as they collect.

Another action of the lime-water is to convert any oil present into stearate of lime. From C the water passes into E for treatment by the soda process. In order to determine if the proper amount of lime-water has been added, a small quantity of water is drawn off into a white porcelain cup by means of the test-cock F, and two drops of phenolphtalein are added to each tablespoonful of water. If sufficient lime-water has been used the solution will show a faint pink tinge of color. If the color remains white it indicates the necessity of more lime-water. A dark pink shows that too much lime has been added and the solution pump should be slowed down.

The soda process is carried on in a similar manner to that just described. The tank G contains a solution of carbonate of soda, or soda ash, which is pumped into the feed-water just as it enters E, causing the formation of lime and magnesia carbonates which are precipitated, and soda sulphate which is soluble and enters the boilers with the water. When the feed-water contains the chlorides of lime and magnesia the effect of the soda ash is to form the carbonates as a precipitate, and sodium chloride (common salt), which in the small quantity produced is harmless. Soda ash also disposes of any nitrate of lime by changing it to the carbonate, which is precipitated, and nitrate of soda, which remains in solution. The greater part of the precipitates formed by the above reactions settle to the bottom of tank E and may be blown off. The various soda solutions which are formed and remain in the water do not form scale or corrode the boilers, but when present in too concentrated a form are likely to cause foaming, which is increased if vegetable matter is also present. The only way of preventing this is by blowing off the boilers occasionally as may be found necessary.

As the water leaves E it should again be tested by adding one drop of phenolphtalein to each tablespoonful of water. The color reactions indicating the proper amount of soda are the same as for lime; the only difference being that one drop of phenolphtalein is used to each tablespoonful of water in the case of soda and two drops in the case of lime. After leaving E the water passes to the filters L and M, which are filled to a depth of four to six inches with fine crushed flint supported upon suitable screens. These remove any suspended matter which may be present and the purified water then passes to the boilers through the pipe T.

After leaving the filter the water should be tested once more by adding six or seven drops of a saturated solution of

caustic soda and soda ash to a small glass, drawn from the test-cock R. If there is more than a grain of scale-forming matter left in the water a precipitate will form, and if less it will remain clear.

The two pressure gauges D and Q show the pressure before entering and after leaving the apparatus, and indicate the resistance offered by the filter, thus informing the attendant when it is time for washing them out. One filter is washed at a time by cutting it out from the rest of the apparatus and reversing the flow through it by a proper use of the connecting valves. This stirs up the flint and carries the accumulated filth and precipitates out through the valve S and drain-pipe U to the sewer. The reason for using flint as a filtering material is because it does not pack and never deteriorates.

Aside from the first cost and maintenance of softening plants is the item of chemicals. This, however, is not great, as lime and soda are both inexpensive.

A good deal of the commercial lime contains a high percentage of magnesia, and unless a brand containing from ninety to ninety-five per cent of lime can be obtained it should be rejected for water-softening purposes. Water containing the carbonates is less expensive to purify than one in which the sulphates are present. The cost of softening water varies from one to two cents per 1,000 gallons, depending upon the impurities which it contains.

ELECTRICAL PURIFICATION OF WATER.

An article of this kind would not be complete without describing briefly one of the methods of purification by means of electricity.

In this method ozone is the active agent, produced either from the oxygen in the air or from the water by the use of electricity.

No minute life can exist in contact with ozone, and all impurities, both organic and inorganic, whether in suspension or solution, are decomposed and form a coagulation of a gelatinous nature which readily settles, leaving pure water at the top of the tank or chamber in which the action takes place.

In plants of medium size the method of ozonizing the oxygen of the water is preferable, as this may be done by an electric current of normal voltage, while in the other method a very high tension is required. The principle of operation is shown in diagram in Fig. 7. Water enters chamber A, which is provided with a pipe-coil for heating or cooling as conditions may require. From A the water flows through a series of electrode tubes, one of which is shown in section, into chamber B. These tubes are arranged in pairs, each pair forming a complete circuit by means of their connection with the anode and cathode plates C and D, which are connected with the leads from an electric current as shown. The water in passing through the tubes fills the space between the anode and cathode, and the induction discharges taking place act upon the impurities as above described.

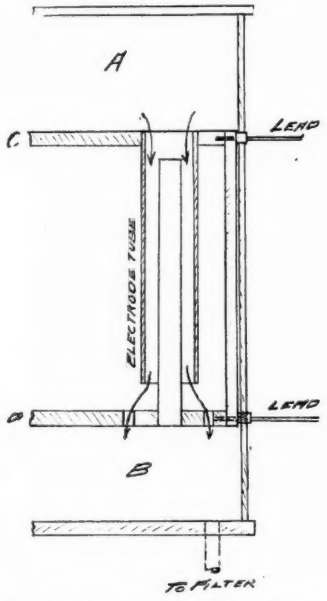


FIG. 7.—ELECTRICAL PURIFYING APPARATUS.

From chamber B the water flows into a filtering compartment, where the coagulated and suspended matters are removed by passing through beds of sand or gravel, and by skimming with a surface blow-off when necessary.

The cost of purification by this process is from ten to twelve cents per 1,000 gallons under average conditions. In very large plants where a current of 10,000 to 12,000 volts is available the type of apparatus for ozonizing the oxygen of the air is preferable. In this case the ozonized air is forced through the water as it flows through closed tanks or towers provided with suitable filters. With large quantities of water the cost of purification should not exceed six to eight cents per 1,000 gallons.

The Faraday Society.

The thirty-second ordinary meeting of the Faraday Society was held on Tuesday, December 17, 1907, at the Institution of Electrical Engineers, 92 Victoria street, S. W., London, England. Dr. F. Mollwo Perkin, treasurer, was in the chair.

Dr. F. G. Donnan, in the absence of the author, read a paper on "A Physico-Chemical Study of the Complex Copper Glycocoll Sulphates," by J. T. Barker.

The paper deals with the constitution of the blue solution formed when glycocoll is added to copper sulphate solution. It is probable that the concentration of the cupri-ions has been lowered by the formation of complex cupri-glycocoll cations, and experiments are described to investigate this question. Electrometric measurements and the application of the mass law point to the existence of complex ions of the formula $[CuG_4]$.. and the corresponding sulphate $[CuG_4]SO_4$. Freezing-point measurements on the whole confirm this. Crystallization experiments show that the first addition of glycocoll to a solution of $CuSO_4$ produces undissociated copper glycocoll with an increase of free H_2SO_4. This initial action is soon brought to a stop by the increasing H. concentration, and after this further addition of glycocoll results mainly in the formation of complex copper glycocoll cations. Conductivity experiments strikingly confirm this supposition.

Dr. F. Mollwo Perkin read a paper on "The Discovery of the Alkali Metals by Davy; the Bearing of the Discovery Upon Industry." The lecture was illustrated with lantern slides.

After a short biographical sketch the author refers to Davy's early experiments on galvanism, which began in 1800 and culminated in 1807 in the electrolytic decomposition of the fused alkalies, caustic soda and caustic potash, described on November 19 in the Bakerian lecture before the Royal Society entitled: "On Some New Phenomena of Chemical Changes Produced by Electricity, Particularly the Decomposition of the Fixed Alkalies, and the Exhibition of the New Substances Which Constitute Their Bases, and on the General Nature of Alkaline Bodies." Davy's experiments are described in detail, and it is shown that the electromotive force of his battery must have been about 220 volts and the current he used something under one ampere. The subsequent experiments on the decomposition of the alkaline earths, by which calcium, strontium, barium and magnesium in the form of amalgams were obtained, are then described.

The second part of the paper deals, among other matters, with the industrial manufacture by Wöhler in 1827 of potassium, by Ste. Claire Deville in 1854 of sodium, with Watt's suggestions (1851) for electrolyzing fused sodium chloride, with Castner's chemical sodium process (1886) and his electrolytic process (1890), Rathenau and Suter's sodium process, Becker's process and the process of Darling, who electrolyzed fused sodium nitrate, using porous partitions.

The Illuminating Engineering Society.

The annual meeting of the Illuminating Engineering Society was held in the rooms of the Electrical Club, of New York city, Friday evening, January 10. At this meeting the several officers submitted their reports, and the result of the recent election of officers was announced. The secretary, V. R. Lansingh, outlined the large amount of work which had been done during the year and showed the growth of the society. The chairman of the finance committee, L. B. Marks, reported for his committee, and showed that, due to the increase in membership, to the increased activity of the sections, and to the greater amount of matter published in the *Transactions*, the expenses of the society had increased considerably. However, the fiscal year had closed with a balance then in the treasury, due to the advertising in the *Transactions*.

President Sharp, in turning over the office to his successor, reviewed the work of the year. He said that about three hundred new members had been secured, and that naturally some of the old members had dropped out. The growth of the year in this respect was encouraging, and it was to be hoped that even greater success could be secured during the coming year.

The working of the new constitution adopted by the society at the first annual meeting was discussed. This constitution represents a departure in technical society organization. One difficulty encountered in this country in the administration of societies of national character has been due to the large area covered. It is impossible, when frequent meetings are held, to have a representative attendance from all sections of the country. It is for this reason that in some societies only one or two general meetings are held. To get rid of this difficulty, certain associations have organized local chapters more or less under the control of the central governing body. This practice has not been in every way a success. The new constitution of the Illuminating Engineering Society was an endeavor to overcome the objections to this method of organization by placing all the working chapters on an equal basis; thus the Chicago chapter should in every way be as influential and important as the New York chapter. To maintain these individual organizations in harmony, there is a general council which merely governs but does not dictate the active work of the sections. To keep the sections and the council in touch a vice-president is elected by each section, who is *ex-officio* a member of the council. It was hoped that in this way the general executive work could be carried out; that the general policy of the society could be guided while the sections would be free in their method of working. Unfortunately the constitution had not worked out as well as had been hoped because of the difficulty of obtaining general attendance at the council meetings, it being impossible for the vice-presidents from distant sections to attend regularly. One year, however, is not a thorough test of such an organization, and it is hoped that as the sections become more familiar with the system, everything will go along more smoothly.

Dr. Sharp also reviewed the technical work of the society during the year, calling particular attention to the success of the annual convention, which was held in Boston last July.

DR. LOUIS BELL,
President, Illuminating Engineering Society.

The report of the tellers appointed to count the ballots for the annual election of officers was then read by the secretary. This showed that the following officers were elected for 1908:

President—Dr. Louis Bell, Boston.

Vice-presidents — Arthur Williams, New York; C. E. Stephens, Pittsburg.

Managers—W. H. Gartley, M. K. Eyre and Bassett Jones, Jr.

Secretary—V. R. Lansingh.

Treasurer—Dr. Arthur H. Elliott.

Retiring President Sharp then introduced the new president, Dr. Louis Bell, who addressed the society briefly and took a very optimistic view of its future. He said that the work for the past two years, had, in his opinion. been eminently successful and the effect had been widely felt, as to-day engineers, architects, fixture dealers, and others, who previously paid little attention to the principles of illumination, are now studying the subject and applying its principles in practice. The great aim of the society, that of bringing together the various interests which have to do with artificial illumination, had certainly been attained, which was something that no other society could hope to do. Dr. Bell looks forward to the future of the society with confidence in its influence in promoting good illumination.

President Bell's remarks were followed by a general discussion of the policy of the society, in which W. D'A. Ryan, F. J. Gilchrist, Arthur Williams, W. H. Gardiner, Dr. A. H. Elliott, V. R. Lansingh, P. S. Millar, and others took part.

The meeting was then adjourned.

Suit Against the Economy Light and Power Company.

Suit against the Economy Light and Power Company, of Joliet, Ill., to prevent the construction of a dam at Dresden Heights, was filed on December 30, in the Circuit Court of Grundy county, at Morris, Ill. The action is in the name of the people of the state of Illinois, Governor Deneen and Attorney-General Stead. An injunction is asked for. It is contended that the Desplaines river is navigable, and the Economy power dam will interfere with the deep-waterway plans. Affidavits are filed from a number of old settlers, to prove that the Desplaines river was used for navigation purposes half a century ago. The arguments are under way before Judge Stough.

Subway to Brooklyn Opened.

The East River Tunnel, extending the New York subway to Borough Hall, Brooklyn, was opened on January 9. The official train, with city and railroad officials, members of citizens' committee, and invited guests, left the Bridge Station, Manhattan, at 11.30 A. M., arriving in Brooklyn at 11.45. Public exercises were held in front of the Borough Hall at 12 o'clock noon, the borough president, Hon. Bird S. Coler, presiding. Addresses were made by the Hon. Patrick F. McGowan, president of the board of aldermen; St. Clair McKelway, William Berri, Frank Hedley and others, after which luncheon was served at the Hamilton Club.

New York Section of the Illuminating Engineering Society.

A meeting of the New York section of the Illuminating Engineering Society was held on Thursday evening, January 9, in the Engineering Societies Building, New York city. At this meeting Dr. H. H. Seabrook presented a paper entitled "Effects of Light Upon the Eye." The author first described the general characteristics of the eye and its construction, explaining the supposed effect of light upon the retina and the behavior of the eye when light falls upon it. He dwelt particularly upon the protection which nature has furnished, and described the results which had been found experimentally when the eye is exposed to unusual conditions.

Passing to the relation between the effects which he had discussed and illumination, Dr. Seabrook said that the severe injuries which had been found to take place under unusual conditions have but little practical bearing upon the work of illuminating engineers. No one expects the demand for brilliant light upon streets or in public buildings to be ignored, and no man expects the new forms of lamp to be replaced by kerosene lamps. There are many other things to be considered in lighting large areas besides the eye, which may be protected from too powerful light fairly well by a change in position and consequent rest to the exposed portions of the retina. Illumination for near work, however, is in a most unsatisfactory state. This country leads the world, apparently, in the brilliancy of its artificial illumination. It certainly leads the world in ocular exhaustion, discomfort and congestion. When gas came into use these troubles began to increase, and a further increase was found to follow the introduction of the incandescent electric lamp. Both here and abroad oculists agree that the kerosene burner is the least harmful artificial illuminant. In fact no damage has been traced to the use of this source of light.

The most satisfactory light is that coming in through a closed window on a bright day. In this light, finer lights and shadows and delicate colors may be best distinguished by healthy eyes. Moving further away from the window than a few feet diminishes vision, while even taking away the protection of the window glass causes more dazzling and decreased retinal endurance. The adaptability of the eye is small for increased illumination and the limits of increase of vision with stronger light are within the medium limits of illumination. The light should come from the rear and fall upon the object. If the latter has a glazed surface which reflects white light, fatigue is more rapid than with a dull surface, for below the surface of objects chemical rays are absorbed. Visibility is due to that portion of the white light which is not absorbed but reflected to the eye from below the surface.

The image of the brilliant filament of the incandescent lamp, with its concentration of light, must harm the retina more than diffuse images of flames. The benefit from ground-glass globes for this lamp must be partly due to diffusion of the light. Without ground glass the light from the incandescent lamps is more steadily brilliant than that from kerosene, gas or the gas-mantle burner, and there is less chance for retina recuperation. In searching for other causes of trouble due to the incandescent lamp, it may be noted that the movable kerosene lamp is usually placed in a good position to illuminate the object, while the incandescent electric lamp is usually not well placed, and when this is the case no amount of shading will correct the conditions. Again, the glass bulb of the incandescent lamp is very thin, compared with the lamp chimney, and since glass absorbs strongly the chemical rays, the lamp chimney is more effective in cutting out these deleterious rays than is the incandescent-lamp bulb.

The Welsbach mantle changes the light from the ordinary gas flame with its marked excess of red to a cold light, deficient in that color. This light is more irritating to some eyes than other light, but less irritating to others.

There is no need to consider any substance except glass for protecting the eyes from too intense light, and yellow is the color to choose to improve vision and to protect the eyes from the chemical action of light. Globes may be used of pink, orange, red or green as desired. For protective purposes that shade of yellow which appears in the best photographic ray filters seems most suitable. This is an amber yellow which may be darkened for weak or unhealthy eyes. Unfortunately this glass is difficult to manufacture without imperfections, and the supply slowly follows the demand.

The final conclusions of the paper were: Lights weak in chemical rays are better suited to the eye than others; present lights may be improved by attention to position, including the distance of the source of light from the eye as measured by the course of the rays, and by protection of the eyes by means of glass properly colored. Take the spectrum of daylight through a window and that of kerosene, argand, Welsbach and incandescent electric lamps, and see what shade of amber-yellow glass it takes to cut off the blue and violet rays. Under these conditions the kerosene burner will be at one end of the list and the incandescent filament at the other.

In the discussion several members took issue with certain statements and conclusions made by Dr. Seabrook. P. S. Millar said that the society is devoted to a campaign against unshaded high intrinsic brilliancy and bad location of sources of light. On these points it is in entire accord with Dr. Seabrook. His third charge, however, that much damage is done by the short wave-lengths or chemical rays, is open to dispute. By referring to spectroscopic curves given by Professor E. L. Nichols, of Cornell, he showed that high intrinsic brilliancy does not necessarily mean that the short wave-lengths are in excess, and it is a noteworthy fact that daylight, which is taken as the ideal, contains perhaps ten to twenty times as large a proportion of the ultra-violet and chemical rays as light from the most brilliant artificial illuminant. It is not questioned that chemical rays do produce injury, but are the injuries at present said to exist due to these rays or to some other cause? The human eye seems better suited for long range vision than viewing small objects close at hand; in other words, it is better adapted to primitive conditions than to our present civilization. The strains due to this cause must have something to do with the injuries which are said to be taking place.

Dr. Louis Bell also differed with Dr. Seabrook as to the direct cause of the injury to the eyes. Two effects are being dealt with: that of the light on the retina and that of the light on the pigmented layer of the retina. The cornea and lens act as filters for ultra-violet rays, becoming more effective in this way with age. The eye itself, however, is very sensitive to yellow. So far as the chemical effect is concerned, all the rays of the spectrum are chemical. Damage to the eye may be divided into two parts: primary lesions from excessive violet light and exposure to concentrated radiations where the amount of energy is large. The tremendous amount of light radiated by the flaming arcs or from a heavy short-circuit is as likely to cause damage as the ultra-violet rays from ordinary light sources.

At this meeting the annual election of section officers occurred. The following were the officers elected for the year 1908:

Chairman—W. W. Freeman.

Managers—Albert Wahle and C. W. Morris.

Secretary—Preston S. Millar.

Electrical Notes from Great Britain.

(By Our British Correspondent.)

THE last day of November was the date upon which all new projects for electric light, power and traction undertakings had to be filed in application form in readiness to come before the attention of Parliamentary committees in the ensuing session at St. Stephen's.

There are few things in the November *Gazettes*. There are some further proposals bearing upon the vexed question of London's power supply, two of them being promoted by existing companies and one by a "stranger." Of the two former the more attractive from most points of view is a joint scheme of some fourteen or more electric light and power companies which are now operating in the area. These desire to set up a joint committee consisting of themselves or their representatives and representatives of the London County Council and other municipal authorities having a real interest in the question of London's future power and light supply. That there would be bills again this year for dealing with this problem was inevitable, considering the position of affairs at the end of last session's deliberations, and at first blush it would seem that this joint-committee proposition, if it gain the concurrence of the London county council, and the support of a number of local authorities, points the way to a reasonable settlement. That is, a settlement which, while providing for future development along progressive lines, shall also protect the rights of existing parties. Much depends upon the attitude of the government in regard to the matter. It has already been many times accused of a socialistic tendency in its legislation, and if it wishes to rebut that charge it is the more likely to adopt this present scheme, or one something like it, for safeguarding the interests of the private investor and the general rights of capital. At a guess we should say that there are something like 10,000 separate share-holdings in the London electric supply undertakings. The other projects just filed include a few new tramway undertakings of more or less consequence, and a number of electricity supply authorities in different parts of the kingdom want to make small extensions of their areas, or obtain powers to supply electricity in bulk to somebody else outside, or to make minor alterations in their existing acts. Into the details of these it is not necessary to enter here. There is a project on foot, known as the "Dublin & Central Ireland Power Scheme," for a company which desires to put down generating stations, etc., and supply electricity in parts of the counties of Dublin and Kildare, and King's county and Queen's county. In regard to railways there are no electrical proposals worth mentioning from the industrial point of view.

Exhibition matters are very much to the fore just now. First we may place on record the unfortunate fact that the Irish International Exhibition which, it was thought, was going to do great things for Ireland, considered industrially, has resulted in a big financial loss. According to reports the deficit amounts to over $500,000, and among the guarantors appears the Dublin United Electric Tramway Company ($62,500), and its chairman, W. M. Murphy ($7,500). In the main, bad weather conditions are blamed. Next we should refer to the rapid progress that is taking place at Shepherd's Bush where the buildings for the Franco-British Exhibition, which opens next May, are springing up. The machinery hall is sufficiently advanced to give one a good idea of the size and imposing character of the buildings. Among the exhibitors who have so far applied for space are Mather & Platt, Limited, of Salford; the Westinghouse Company, C. A. Parsons & Company, Power Gas Company, Vickers, Sons & Maxim. It is also stated that French electrical firms are to be well represented. The gas lighting and engineering companies are making elaborate preparations for a good display of gas illumination, heating and cooking, and this fact is being used in trying to work up an interest on the part of the electrical trade. There is little prospect of electrical traders taking special stands of their own for a six months' show of this description, so the electrical committee, with Dr. R. T. Glazebrook as its chairman and C. S. Northcote as its organizer, is trying to secure what we might term a cooperative electrical exhibit showing the things that can be done by means of electricity. Firms have been invited to subscribe toward a joint exhibit. The original plans of the Franco-British Exhibition showed a "Hall of Electricity" near the Wood Lane entrance.

Referring lastly to the Manchester Electrical Exhibition, to be held in October next, electrical trade meetings have been held in Manchester and in London concerning the preliminary arrangements. On the executive committee all departments (contracting, manufacturing, electricity supply and so on) will be represented. When the committee is complete, which it will be very shortly, and when a sufficient sum toward the heavy expenses has been guaranteed, the scheme will be circulated in detail among the trade.

The various electrical and other institutions have been very busy indeed with papers and discussions during the last month. At the London Institute of Electrical Engineers' meeting on December 5, J. Pigg, of the North Eastern Railway, contributed a lengthy, but interesting, paper on "Automatic Cab-Signaling on Locomotives," in which he gave a description of the Raven system which is being employed experimentally on part of his railway. At the previous meeting of the same section, Dr. Robert Pohl introduced "The Development of Turbo-Generators," and in the discussion thereon several experts in that department took part. At Sheffield, W. H. F. Murdoch has been dealing with the "Magnetic Testing of Iron," while at Birmingham "Torque Conditions in Alternate-Current Motors" has been V. A. Fynn's theme. At Manchester, H. W. Wilson followed up a paper read several years ago with some further remarks on the electrical operation of textile factories, showing what excellent progress has recently been taking place in this line in the Manchester district. Another paper read before this section was prepared by T. F. Wall, on "The Reluctance of the Air-Gap in Dynamo Machines." The Dublin section has had before it a matter of quite Irish interest, owing to the wide expanse of bog-land existing in that ill-favored isle, T. Tomlinson having entered in some detail into the old, yet new, subject of the production of power from peat. The Leeds local section has been occupied with the commercial aspect of electric power supply, the paper in this case being appropriately prepared by W. B. Woodhouse, of the Yorkshire Power Company, which is building up a power business in the Leeds and surrounding district.

On December 13 the Physical Society of London held its annual exhibition of electrical and other apparatus, and on the same day the Electro-Therapeutical Section of the Royal Society of Medicine held its annual exhibition and conversazione in London. ALBERT H. BRIDGE.

London, January 1.

REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

A Coil-Winding Machine.

A description is given here of an adjustable coil-winding machine devised by W. Cramp. In this device all sections are separately adjustable so that coils of any dimension and shape may be wound. The coil is wound in the usual way, flat, then by the removal of two pins part of the frame may be drawn out sideways so as to give the coil the requisite form for fitting in the slots on the armature core. The one machine is capable of winding coils for ranges from one-quarter of a kilowatt up to fifteen kilowatts. After being brought out it was adopted by a number of the permanent dynamo and motor manufacturers in England, as it saves a great deal of time and space in the shop.—*Abstracted from the Electrical Engineer (London), December 20.*

Magnet Coils of Bare Uninsulated Wire.

A brief description is given here of a system of winding magnet coils, devised by A. Grothe, in which bare wire is employed. The idea is that if two adjacent turns of wire make only a line contact, the resistance of this contact will be so great, compared with the resistance of the length of one turn of wire, that the current will flow through the wire rather than across the contact. If, then, a coil consists of but a single layer of wire, it should not be necessary to insulate this wire, as the resistance of the contact will be sufficient to prevent short-circuiting. This does not apply, however, to a second layer of the wire, since the latter would come in contact with the layer below and the resistance of the contact might be small compared with the total resistance of the intervening turns of wire; but this difficulty is overcome by placing a sheet of paper or other insulating material between the consecutive layers. The system is limited somewhat by the diameter of the coil of wire. If the latter be large and the wire small, current may pass across from turn to turn; hence the system is only suitable for large coils when the latter are to be wound with fairly large wire. It is said that coils wound in this way have proved satisfactory.—*Translated and abstracted from L'Electricien (Paris), December 7.*

Telegraphs in China.

A brief summary of a recent report prepared by Sir Alexander Hosie, acting commercial attaché to the British Legation at Peking, which deals with the telegraphs, railways and mining in China, is given here. That part dealing with the telegraphs is interesting. At the end of 1906 the imperial Chinese telegraph administration had a system of 22,419 miles, with 34,473 miles of wire and 946 nautical miles of submarine cable. There were 379 offices, of which sixty-two were open day and night, the others during the day only. The number of instruments in actual use was 768. The general operating staff consisted of 3,175 men, while the inspectors and linemen amounted to about 2,400. In addition to this equipment there are many special provincial lines usually constructed by the administration, but worked and managed independently by the provincial authorities. A number of foreign companies have connections with China. There is a French cable at Amoy; a German cable from Shanghai to Kiaochow and Chefoo, and a third cable, partly Chinese, from Chefoo to Port Arthur. The last was cut during the war between Russia and Japan, and is not yet repaired. China also has telegraphic connection with Burma, Indo-China, and Russian Siberia. —*Abstracted from Engineering (London), December 27.*

Four-Wire Distribution.

A system of electrical distribution is here proposed by H. H. Jowers which is intended to take the place of the ordinary three-wire system and yet have some of the simplicity of the two-wire system. The idea is to distribute on a three-wire system, using, however, two concentric cables laid side by side for this purpose. The cores of the cables are to form the outers of the system, while the outer rings of each cable form the neutrals. The great advantage claimed for this system is that of safety for maintaining the supply, as it is practically impossible for a ground to form on either outer. The cost of the system is that of two concentric cables, which may be compared with three single cables or a triple-concentric cable. If the cables are laid on the solid system—that in which they are surrounded by a solid insulating material, such as bitumen, in a trench—the three single cables would be a little cheaper. With a two-concentric-cable system a good waterproof lead covering is provided for the main and there is little danger of getting a short-circuit to the lead, for should the insulation of either the positive or the negative wire break down, it would merely cause a short-circuit to one neutral conductor. This would confine the fault to one spot and obviate all danger of a large current flowing along the lead and damaging the cable at the poorly bonded joints. Should such a fault occur on a section having a large power consumer, this would naturally be across the one outside wire. In this case the damaged neutral could be disconnected and the supply turned on again, so that only one-half of the lamps would be out. In such a system fuses could be inserted in the neutrals at section boxes which would quickly localize any faulty piece of cable.—*Abstracted from the Electrical Review (London), December 27.*

Magnetic Oscillators as Radiators in Wireless Telegraphy.

Oscillators of the open or Hertzian type are usually called electric oscillators since the effects produced in the external field are to a large extent determined by the potentials of the free electric charges which alternately make their appearance at the open ends. If, however, the oscillator consist of a metallic circuit completed by a condenser, the plates of which are very near together, the effects on the external circuit are mostly or largely determined by the current in the circuit, and little, if at all, by the condenser-plate charges, because these, being of opposite sign and near together, neutralize each other's effects in the field. Such a closed, or nearly closed, circuit is called a magnetic oscillator, and the possibility of employing such for wireless telegraphy is here discussed by Dr. J. A. Fleming. The author first deduces an expression for the energy radiated by the oscillations of an open circuit in ergs per period. This is proportional to the square of the maximum electric moment or the product of the maximum static charge on each end and the distance between them, and inversely proportional to the cube of the wave-

length. The ratio of the length of the oscillator to the wave-length may be determined experimentally, but for linear oscillations it is approximately 0.4; hence for an oscillator radiating undamped waves the power radiated in watts is given by the expression $W = 126\ a^2$. Here a is the effective value of the current at the centre of the oscillator. It is proportional to the frequency. Considering the case of a perfectly closed oscillatory circuit having an area S and traversed by undamped or persistent oscillations which have an effective value a, it can be shown that such a closed circuit also radiates energy, the amount of which is given by the equation $W = 4 \times 10^{-38}\ S^4\ a^2\ N^4$. Here N is the frequency. The corresponding equation for the open oscillator is $W = 87 \times 10^{-20}\ l^2\ a^2\ N^2$, l being the length of the oscillator. These formulæ show that in the case of the open or electric oscillator the power varies as the square of the current and also as the square of the frequency; whereas in the case of the closed or magnetic oscillator it varies as the fourth power of the frequency. Accordingly, in oscillators of the latter type the radiation is slow unless the frequency be very high. For the purposes of theory it is most convenient to consider the closed oscillatory circuit as made up of a series of Hertzian or dumb-bell oscillators placed in series, with their electric poles of opposite side overlapping. The nature of the magnetic field can then be determined by summing up the different fields due to the elementary oscillators. To obtain some information as to the actual distance effects of such closed oscillators, and to ascertain whether true radiation was at all influential in producing the inductive action of one closed oscillatory circuit on another at modern distances, or if the whole of the action should be accounted for by ordinary electromagnetic induction, a number of experiments were conducted. Two circuits were employed for this purpose, constructed by winding a few turns of highly insulated copper wire around a wooden cross. The experiments consisted in setting up continuous or undamped oscillations in one of these coils by means of a Poulsen arc and then measuring the current created in the corresponding coil when placed at a distance by means of an oscillation valve. An analysis of the closed-circuit oscillator shows that its radiating power was extremely small compared with that of an open oscillator of the same order of linear dimensions. When the two circuits are closer together than the wave-length of the radiation, the effect may be considered as the result of ordinary magnetic induction or the creation of secondary currents produced by the ebb and flow of the lines of magnetic force permanently connected with the primary circuit. Nevertheless, the experiments show that such circuits may act appreciably on one another at very considerable distances when the primary circuit of one is traversed by a high-frequency current and the circuits are in resonance with one another. The author points out that early attempts to obtain wireless telegraphy by means of such effects were not successful because of the relatively low-frequency currents employed in order that the telephone receiver might be used, but when such circuits were put in resonance, the disturbances caused on commercial telephone circuits restricted the possibilities of its use.—*Abstracted from the Electrician (London), December 27.*

A High-Tension Laboratory for a Porcelain Insulator Factory.

A description is given here of the laboratory and methods of testing high-tension porcelain insulators manufactured by Hermsdorf-Klosterlausnitz, Saxe-Altenbourg, Germany. This is one of the most important laboratories in Europe. It was equipped in 1901 and has been considerably enlarged from time to time. In the tests to which the insulators are submitted particular attention is paid to the arrangements necessary for submitting each part of an insulator to a test before assembling them; for determining under what tension an arc will pass over the surface of the insulator to the pin in order to fix the potential for which the insulator is serviceable, and in the construction of apparatus for putting insulators to mechanical tests, particularly traction tests, exerted on the pins. There are six testing rooms, one of which is reserved entirely for tests in oil. These tests are made in order to avoid discharges over the surface of the insulators and to determine the potential at which they are punctured. The usual routine tests do not differ much from those given in this country. One of the most important tests is that for the resistance of insulation. It is obtained by placing the inverted insulators in water, filling the interior with water, and applying a high potential. All tests are made at a frequency of fifty cycles. The current is furnished by four transformers, three of which are rated at ten kilowatts, and will deliver either 50,000 or 100,000 volts. They may be used for voltages up to 150,000 by coupling them in series. The fourth transformer has a rating of fifty kilowatts and its maximum potential is 200,000. This transformer may also be used for delivering currents at 100,000 volts. The first three transformers are placed in one room and the fourth is in a room by itself. Electrical connection between these rooms is provided by means of rods passing through long, corrugated porcelain insulators placed in the wall. Screens are placed around these insulators to prevent discharges from striking the wall. Current is supplied for testing purposes from two dynamos, which will deliver direct, single, two or three-phase currents as desired. Unusual care has been taken in the arrangement of these laboratories to protect the working force. Each room is divided into two parts by a railing which separates the testing table from the controlling switchboard. Current can not be turned on to the testing table until this railing is closed; and, on the other hand, this railing can not be opened until the high-tension circuit is itself opened. In addition, a red incandescent lamp is automatically lighted as long as the electrical circuit is closed. When it becomes necessary for one of the employés to approach one of the testing tables, he wears a suit of woven metallic armor. Insulators for not more than 2,000 volts are tested at a tension six times that for which they will be used, and the test is applied for fifteen minutes, the pressure being maintained constant. If any insulator breaks down during this test, the circuit-breaker automatically opens and at the same time an alarm is sounded. This renders it unnecessary for an attendant to be present during the entire test. Large insulators for high voltages are tested at only double the service potential. One room has been arranged for submitting insulators to all sorts of conditions. By means of pipes a shower of water may be thrown at any angle desired, the room may be filled with steam or the air may be dried. In addition to this the roof of the building is fitted up for testing insulators under actual atmospheric conditions so as to determine the effects of snow and sleet. A testing machine is provided by means of which the insulators may be submitted to all kinds of mechanical tests. These consist of traction tests on the pin, of horizontal strains on the head of the insulator, these sometimes amounting to four tons, etc.—*Translated and abstracted from L'Eclairage Electrique (Paris), December 14 and 21.*

Methods of Getting New Business

A DEPARTMENT DEVOTED to the COMMERCIAL DEVELOPMENT of CENTRAL STATIONS

Managers are Invited to Contribute Suggestions for Methods of Increasing the Demand for Electric Service

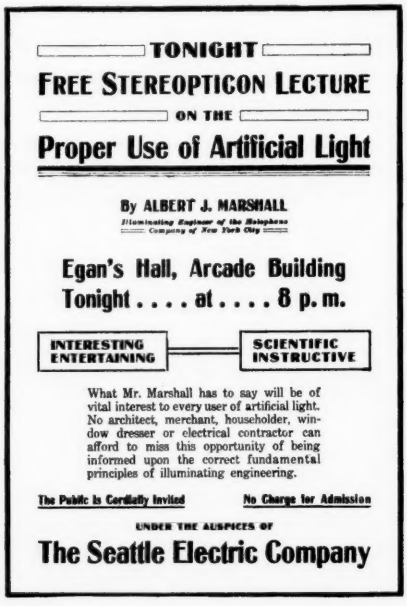
One of the results of the contraction in business which is being felt, more or less, in all parts of the country has been a disposition upon the part of central station managers to curtail their expenditures for advertising literature and publicity, thus hampering the good work which has received such an impetus for the last year or so. This is indeed unfortunate, as in no line of endeavor is the cumulative effect so noticeable as in creating a demand for a wider utilization of electricity for all forms of service. The year just closed was fruitful indeed in the introduction of many new ideas in spreading the gospel of a better utilization of electrical de-

THIS HOUSE
IS WIRED FOR
ELECTRIC
CONVENIENCES
Call Us, Phone No. 2429 and Our Man Will
Call and Arrange With You For Electricity
MARION LIGHT & HEATING CO.

vices, and the expenditure in this direction was enormous.

Among the companies which made a very successful utilization of advertising literature and attractive advertising features was the Marion Light and Heating Company, of Marion, Ind. The town of Marion is exceptionally well lighted, and the company adopted a number of novel and original schemes for advertising electricity. One of its ideas was to use large rental bulletins about eight feet high and five feet wide. Upon the face of these bulletin-boards were listed a number of houses which were for rent and which were wired for electricity by the Marion Light and Heating Company. The addresses of the houses were given, the name of the agent and the rent charged. The bulletins were kept up to date, and at no time were there less than six or seven places scheduled. The scheme proved very satisfactory to the lighting company and to the owners and agents of the buildings. It had a decided tendency to make the owners wire up their buildings so as to take advantage of this free advertising. The bulletins were illuminated at night and were very effective in attracting attention to the houses listed. In connection with this service the company made use of large posters, twenty-two inches deep and twenty-seven and one-half inches wide, which were placed in the windows of the houses to be rented, and which were wired for electricity.

During the year the Holophane Company maintained an excellent lecture service, which was at the disposal of central stations throughout the country. The accompanying illustration shows a quarter-page advertisement from the Seattle (Wash.) *Post-Intelligencer*. inviting prospective patrons to a public demonstration, the lecture feature treating of the fundamental principles of illumination, combining primary instruction in practical engineering and non-technical expositions of good and bad practice in lighting. These lectures were invariably well attended by people whom it was desirable to interest. This branch of the Holophane Company's activities is a distinct departure in educational work along the lines of


TONIGHT
FREE STEREOPTICON LECTURE
ON THE
Proper Use of Artificial Light
By ALBERT J. MARSHALL
Illuminating Engineer of the Holophane Company of New York City
Egan's Hall, Arcade Building
Tonight . . . . at . . . . 8 p. m.
INTERESTING ENTERTAINING
SCIENTIFIC INSTRUCTIVE
What Mr. Marshall has to say will be of vital interest to every user of artificial light. No architect, merchant, householder, window dresser or electrical contractor can afford to miss this opportunity of being informed upon the correct fundamental principles of illuminating engineering.
The Public is Cordially Invited
No Charge for Admission
UNDER THE AUSPICES OF
The Seattle Electric Company

illuminating engineering and proved very valuable to those companies which took advantage of the opportunity.

Ben Alten Block, of New York city, has been doing a big business among cen-

tral stations throughout the country in furnishing line drawings illustrating, in a characteristic way, various applications of electrical service. The accompanying illustrations show some of the sketches

which have been used to great advantage by such companies as the Beaumont Ice, Light and Refrigerating Company, Beaumont, Tex.; the Scranton Electric Company, Scranton, Pa.; the Quincy Gas, Electric and Heating Company, Quincy, Ill.; The Edison Electric Illuminating Company, Brockton, Mass.; the Haverhill Electric Company, Haverhill, Mass.; the New Bedford Gas and Edison Light Company, New Bedford, Mass., and the Iowa City Electric Light Company, Iowa City, Iowa.

The convincing value of demonstration rooms has been emphasized in dozens of cities throughout the country. A very interesting contribution to the January number of the "General Electric Review," published by the General Electric Company, containing the views of E. L. Callahan on the subject of "Practical Demonstrations Are Convincing," is reproduced below in its entirety, and will be found of immediate interest to all concerned in the sale of electricity for light and power.

PRACTICAL DEMONSTRATIONS ARE CONVINCING.

BY E. L. CALLAHAN.

In this day and age, when so many new devices and labor-saving conveniences are being brought before the people, in order to call attention to any particular one, it seems necessary to show the buying public just wherein that one excels, is particularly desirable, or well adapted to their use.

This is especially true of electric heating devices, for so many people are satisfied if results can be obtained, regardless of whether they are accomplished under favorable conditions or under unfavorable ones with arduous labor. Central stations and electrical concerns that have devices for sale have therefore found it very advantageous to their business to show their customers, by means of demonstrations, just how cooking by electricity can replace cooking by other means—how much labor, time and expense can often be saved by using electric irons in the laundry, and electric heating appliances in the industrial field.

Throughout the last year or two there has been scarcely a food show held that did not contain booths with extensive displays of electric cooking and heating devices, and practical demonstrations of electricity replacing gas for heating. It has become quite the custom for electric light companies to have brilliantly lighted and tastefully arranged and decorated booths at these shows, with several demonstrators in white aprons and caps busily engaged in cooking and baking, and offering dainty bits of cake and coffee to the many interested visitors.

At one food show which I visited about two weeks ago I found that, with two or three exceptions, every booth that needed heat was utilizing the electric current, and the management felt secure for the reason that the fire hazard was reduced to a minimum.

Many cities have an electric show annually, and since it is a recognized fact that things in motion attract attention, most of these shows depend upon electric novelties and electric heating devices for special features of the exhibitions.

These public demonstrations are not confined to the large cities, but have been taken up and carried through very successfully during the last year by many small towns and cities throughout the United States. In towns of 10,000 or over there is scarcely an electric light company that does not have an exhibition and demonstration room. In many cities these are not elaborate, but they are the nucleus for a new-business department that will surely bring rich returns to the aggressive companies in the near future.

Ironing Day is Picnic Day
with an Electric Fan and Iron;
saves a thousand steps.
Fits any socket - Fits any pocket
Edison Electric Illuminating Co
of Brockton 78 School St Tel. 254

At state electrical conventions the managers of many lighting companies, who have given little time to pushing the sale of current-consuming devices, have been convinced, after hearing reports from those who have been pioneers in pushing the new-business methods, that their plants are not earning what they should. They have gone home with the resolve that they would take steps to secure an exhibition and demonstration room, with some one in charge who would visit customers in their homes and show them twentieth-century methods.

It has been learned that carefully chosen solicitors will be received in the homes of the electric light company's customers, as the latter are glad to learn of the new conveniences that are being offered.

The domestic science departments of the various women's clubs are enthusiastic on the subject, and are doing much to help the lighting companies to advertise electric heating devices. An example of this was shown early last spring in a town of about 40,000 inhabitants, where the domestic science departments of these clubs secured a renowned lecturer who had taken up electric cooking, with the result that about twenty per cent of the inhabitants attended during the two daily sessions held for ten days. The electric supply companies and lighting company did everything possible to aid them in making attractive exhibits. The main feature was a six-room cottage, complete to the smallest detail, which was located in the auditorium, and through which each visitor might walk and see what his or her home could be made like by the use of electric labor-saving conveniences and proper lighting effects.

I am positive that the same success could be attained in nearly every city in the United States, with excellent results and benefit to the electric company. At these lectures ladies secure valuable recipes for baking and cooking, having first seen them demonstrated, and those present are made to feel that they are being favored, rather than that they are conferring a favor on those in charge by attending.

It was demonstrated in the cottage above referred to that the week's washing, drying and ironing could be done in from two to three hours' time, and with almost no labor. To accomplish the drying, a rough board box, about four feet by twelve feet by six feet high, was built and the clothes quickly dried by electric heaters and fans.

Recently, in a city in Kansas where there had been little activity on the part of the local lighting and gas companies, the public was treated to a surprise through a change of management. The gas and electric companies combined and tried to outdo each other in presenting the more interesting programme at a practical cooking demonstration and course of lectures on domestic science. In the electric cooking demonstration a comparison was drawn between cooking in the old way and in the new way.

The above illustration will show that the expense of providing the necessary

equipment to carry on such a practical demonstration is not great. The smallest central stations can well afford to teach their customers to use current-consuming conveniences, for the money thus spent will come back to them through increased bills for larger current consumption by the satisfied customers.

In Grand Rapids, Mich., a course of lectures by the eminent lecturer referred to above has just lately closed. The lectures were held in the Press Building and the electric light and power company were silent partners, although they were back of the whole scheme, and were the builders of the model cottage through which each visitor had to pass to reach the lecture hall. As a result it was the most popular attraction in town for two weeks, and was the means of demonstrating the practicability of electric cooking to just the class of people that the lighting company wished to reach.

This kind of advertising is effective, and when followed up by personal solicitation brings profitable business.

The Edison Illuminating Company of Detroit, Mich., has one of the most completely equipped demonstration and show rooms to be found anywhere. Nearly every current-consuming device, from a two-candle-power lamp to a refrigerating machine, is installed ready to operate before the customer. A model electric kitchen in tile does not leave the inquiring customer much room for imagination, for everything is as it should and could be at home.

Demonstrators can better impress customers when they can show and operate kitchen devices in a kitchen, luminous radiators in a bathroom, bedroom or living room, and ironing in a laundry. Nearly 1,000,000 electric irons would not be in use to-day if the central station had not given the customer an opportunity to demonstrate that they would do the work.

A leading department store in Chicago realizing that, with the extensive advertising of the lighting company and the desire of the people to buy new things, it would be to their advantage to put themselves in a position to supply the demand, arranged with the lighting company to have an exhibition and course of lectures on cooking by electricity held in their dining room. The hundreds of shoppers who patronized their restaurant, and those who came for the lecture, went away quite enthusiastic over the interesting subject, and were especially delighted with the electrically cooked dainties.

The best scheme that I know of for giving the people a correct knowledge of the cost of operating these various devices is used by the Edison Sault Electric Company. Placed at one end of the demonstration room, and just outside of the fully equipped model kitchen, is a meter with a pasteboard dial having a circle described upon it, twelve inches in diameter and divided into twenty equal segments.

This is an old-style five-wheel or dial meter, the fifth wheel of which revolves once for each kilowatt registered. By extending the shaft three inches and attaching an aluminum hand, the current consumption in cents can be read by the observer at a glance; for instance, since the rate for cooking at Sault Ste. Marie is two and one-half cents per kilowatt-hour, if a broiler taking 1,500 watts is used thirty minutes, the pointer will move 270 degrees around the dial, or show a cost of one and seven-eighth cents. The dial may be divided in any manner which best suits the rate in use.

It seems to me that the central station manager should make every effort to teach his customers the relative values of various apparatus as current consumers, compared with the best-known standard. The custom of many stations is to use the sixteen-candle-power, fifty-watt incandescent lamp as the standard. It is probable that this will not be a standard very much longer, but this standard is now more comprehensible to the layman than any other, and if he could see the relative current-consuming value of the sixteen-candle-power lamp and a two-kilowatt air-heater on a dial such as described above, the central station complaint department would not have so much work in adjusting customers' bills and satisfying them that they had used all of the current with which they were charged.

If the customer is taught enough about electric measuring instruments to convince him that they measure the current accurately, and only when light, heat or motion is obtained, the central station man will relieve himself of the greater part of the complaints now received, and at the same time increase his revenue.

Rochester Railway Employés' Association.

The eighth annual ball of the Rochester Railway Employés Association was held at the Eureka Club, Rochester, N. Y., on Tuesday, January 7. The entertainment committee was composed of Fred Livernash, chairman; Edward J. Cook, Joseph C. Collins, William O. Ingle, Herman E. Hicks, John H. Vander Linden and Joseph W. Hicks.

Westinghouse Reorganization Plan.

A plan for the reorganization of the Westinghouse Electric and Manufacturing Company has been practically perfected by the reorganization committee. The plan in its general outlines has been adopted by the unanimous vote of the members of the committee, but is still subject, before its adoption, to the consent of noteholders and bondholders and to the raising of $7,000,000 from George Westinghouse and his associates by the sale of stock to them.

The principal provision of the plan contemplates the creation of a first mortgage bond issue of $45,000,000 to bear interest at five per cent. Of the entire issue $18,500,000 will be convertible bonds and be offered in exchange for the $18,500,000 outstanding convertible five per cent gold bonds. The remainder will be without the conversion privilege and will be utilized to pay off the floating indebtedness and outstanding short term notes and debenture certificates.

According to the report of Haskins & Sells, certified accountants, the company had on the date of the report a floating indebtedness of $14,000,000. It is proposed to fund most of this indebtedness by offering to creditors the new bonds, dollar for dollar, for their claims. Similarly, holders of the $1,969,000 debenture certificates, of the $6,000,000 six per cent collateral notes due August 1, 1910, and the five per cent French loan due October 1, 1917, are to be asked to exchange these securities, dollar for dollar, for the new bonds. The floating and funded indebtedness of the company amounts to between $43,000,000 and $44,000,000.

In order to provide working capital the plan contemplates the sale of $7,000,000 stock at par. It is understood that George Westinghouse and his associates have agreed to take this stock or at least such portion of it as is not desired by stockholders. According to the terms of the plan it is understood that the raising of the $7,000,000 is to be effected without anything resembling an assessment on the stock. There is now outstanding $4,000,000 preferred stock and $24,000,000 assenting stock. The new stock will be of the latter class.

The committee that has been in charge of the plan consists of Richard Delafield, president of the National Park Bank; James N. Jarvie, chairman; Albert H. Wiggin, vice-president of the Chase National Bank; Paul M. Warburg, of Kuhn, Loeb & Company; F. H. Skelding, president of the First National Bank of Pittsburg; Charles A. Moore, of Manning, Maxwell & Moore; Neal Pantoul, of F. S. Moseley & Company, of Boston, and A. G. Becker, of Chicago.

INDUSTRIAL SECTION

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS

Tungsten Series Incandescent Lamps.

The city of Grosse Point, Mich., has recently installed a series tungsten incandescent street lighting system where the advantages of this kind of lighting are well exemplified. The station equipment consists of two 8.8-kilowatt, 5.5-ampere, constant-current transformers. One of these is held in reserve, while the other supplies current to seventy-seven sixty-candle-power General Electric tungsten series incandescent lamps, suspended from artistic iron poles. All wiring is laid in conduits to the poles and wires pass up the centre of the pole to the lamps. The form of poles used not only gives a very substantial line construction, but makes a much more artistic appearance than the usual wooden pole. These poles and lamps are shown in Figs. 1 and 2.

FIG. 1.—STREET SERIES TUNGSTEN LAMPS ON DOUBLE-ARM IRON POLE.

FIG. 2.—STREET SERIES TUNGSTEN LAMPS, GROSSE POINT, MICH.

One of the interesting features of this system is the radial reflector with which the lamps are equipped. This form of reflector, which was recently developed by the General Electric Company, is so constructed that the light is spread and projected very evenly over considerable area instead of being nearly all concentrated in a circle around the lamp. Fig. 3 shows the candle-power distribution of a forty-candle-power series tungsten lamp equipped with a radial reflector. Fig. 4 shows one of these reflectors on a lamp. It may be seen from the diagram of the candle-power distribution that at about thirty degrees below horizontal the effective illumination is fifty candle-power, making the efficiency at this point about one watt per candle-power.

The series sockets with which these lamps are provided are so constructed that when a lamp is removed from the socket two contact plates of large area close together before the lamp is quite drawn out of the socket, leaving no danger of an open circuit at any time.

Tungsten series lamps are made in thirty-two, forty and sixty-candle-power sizes with current ratings of 4, 5.5, 6.6 and 7.5 amperes and are exceedingly hardy on account of the heavy, short filament. They will burn for nearly 1,000 hours at an efficiency of from one and one-quarter to one and one-half watts per candle-power.

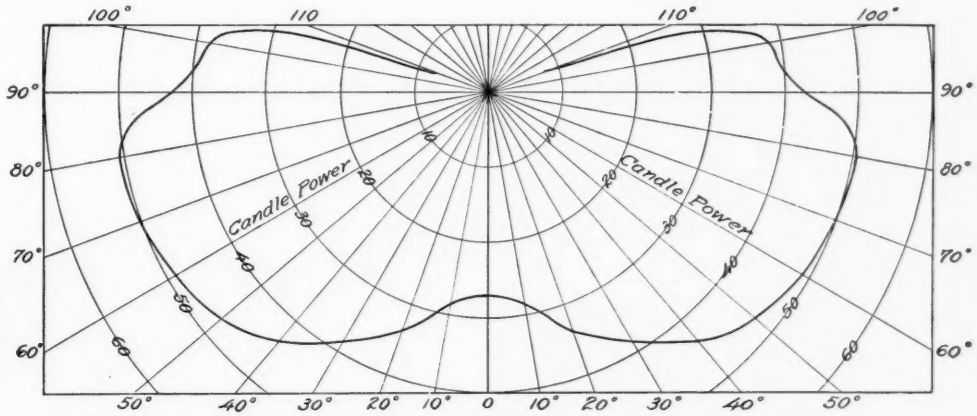


FIG. 3.—CANDLE-POWER DISTRIBUTION OF FORTY-CANDLE-POWER SERIES TUNGSTEN LAMP EQUIPPED WITH RADIAL REFLECTOR.

Another installation of series tungsten lamps for street lighting has recently been made in Grand Rapids, Mich. The lamps are of sixty candle-power and were placed on one of the principal streets of the city. Judging from the complimentary remarks of the press and the city council, the test installation has proved highly satisfactory.

FIG. 4. -LAMP BRACKET AND SERIES TUNGSTEN LAMP WITH RADIAL REFLECTOR.

The tungsten lamp, with its high efficiency, should greatly increase the use of series incandescent lights in suburban and residential districts where the thick foliage makes it necessary to have the units distributed at short intervals to produce satisfactory illumination.

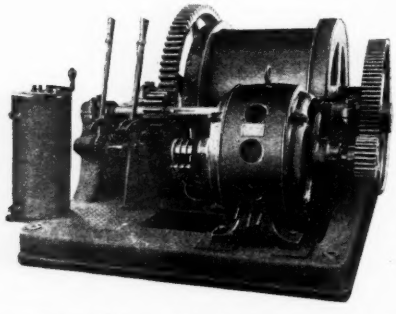
Small Electric Hoists.

The Allis-Chalmers Company, Milwaukee, Wis., is offering a new line of small electric hoists, which are made in five sizes for the single-drum and six sizes for the double-drum units.

Substantial design and workmanship, simplicity, accessibility of all parts, absence of loose joints, and, for the single-drum hoists, a bed-plate cast in one piece to insure rigidity, are features which characterize this line of product.

The one-piece bed-plate referred to is designed with especial care so that the strain due to the pull of the rope is taken care of by the distribution of metal in its forward slopes, which forms a rigid truss in the direction of the strain, as the pull of rope in an upward direction and the weight of the drum, etc., in a downward direction, react through the metal in the front part of the bed-plate in about the direction of slope, so that nothing could be made more rigid than this construction.

Another feature of the Allis-Chalmers



Induction Motor Geared to Fifty-Horse-Power Single-Drum Hoist.

design is the fact that nothing projects below the bottom of the bed, so that the hoist can be placed directly on a perfectly flat foundation, whether concrete or wood, and there is no necessity of cutting out for gears, etc. There are no projecting foundation bolts, bosses, joint bolts or extended operating mechanism, so often seen on electrical hoists. This fact insures a clean sweep around the machine with no chance for dirt to lodge in the corners. Allis-Chalmers motors are used for these hoists and a wide range of standard sizes is available from which to choose.

Two types, "K" for direct current and "ANY" for twenty-five and sixty-cycle alternating current, all series-wound for hoisting service, are used exclusively. The sixty-cycle motors, wound for 440 volts, are kept in stock, with suitable controllers and resistance boxes, and complete units for fifteen, twenty-five, thirty-five and fifty-horse-power single-drum type are ready for immediate shipment.

A NEW ELECTRICAL MEASURING INSTRUMENT FOR ALTERNATING CURRENTS AND POTENTIALS.

BY JOHN M. LEA.

The "repulsion" meter, for alternating-current measurements, will eventually occupy the same place in the alternating-current field as the "permanent magnet, light-pivoted coil" type in the direct-current field. A meter of this type was developed, designed and patented by the writer within the past two years (application filed June 4, 1906; allowed November 12, 1907) and has been manufactured and recently put on the market by the International Electric Meter Company, Chicago, Ill.

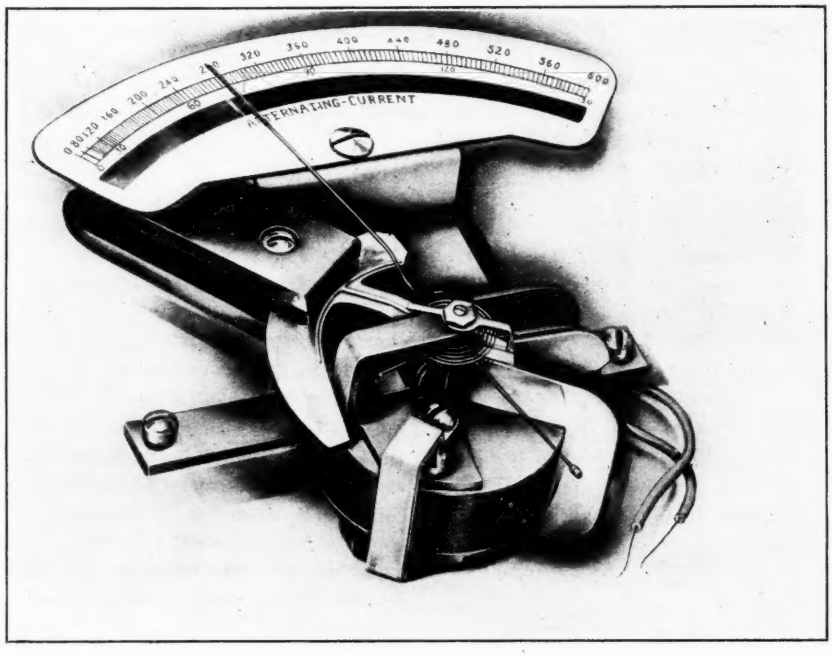


Fig. 1.—The Movement of the Repulsion Meter for Alternating Currents and Potentials.

The principle and design of this instrument is an entirely new and distinct departure. It responds quickly and positively to sudden changes in potential differences or current strengths. The moving system has very little inertia and relatively high torque, is light, rigid and durable. The calibration is permanent and accurate.

An idea of the appearance of the movement may be had by reference to Fig. 1. Fig. 2 is the moving element or coil with index and pivots. The coil stamping, which is composed of aluminum, is only eight mils in thickness and is made so nearly balanced that very little counterweight need be added to the moving parts for poising and balancing, and therefore the whole system is extremely light. When complete with pointer, counter-weights and pivots the weight is only thirty-five grains, or about two and one-third grammes.

The power required for the operation of the "repulsion" meter does not increase in the same proportion as in other types because the current decreases as the voltage capacity of the meter increases. For example: A 500-volt voltmeter has a full-scale current of approximately 0.007 amperes and consumes less than three watts. The impedance is about 137 ohms per volt or 68,500 ohms, while the series resistance alone is about 112 ohms per volt or 55,996 ohms.

Referring to Fig. 3 and to the description and explanation following, a clearer idea of the instrument, its principles and its action may be obtained. In its element this instrument embodies the principle of a short-circuited transformer, consisting of a primary or exciting coil A adapted to carry the current or a part of the current to be measured, and a secondary element or closed coil B linked in inductive relation to the primary by a suitable laminated iron core C, constructed to give a completely closed (no air-gap) magnetic circuit. The primary and secondary, just mentioned, are so mounted as to have a relative movement under the influence of their mutual repulsion when the primary is traversed by an alternating current. Such movement of the secondary B is opposed by two

nicely tempered phosphor-bronze spiral springs (coiled or acting in opposite directions to eliminate "zero trouble"), so that the extent of movement will be dependent upon the strength of the primary current and will indicate such strength of current. To increase the sensitiveness of the instrument, the supplementary or adjustable secondary circuit D, which has an attractive effect, was provided upon the core near the extremity of the swing of coil B. The magnitude of this effect is proportional to the distance of this secondary from the end of the swing of the coil B; the further away the less the effect. This feature is made use of in adjusting the contour of the scale in calibration.

Thus the movable secondary coil B is arranged to oscillate along the curve of the core C between the fixed primary A and the adjustable or fixed secondary D, being simultaneously repelled by the primary and attracted by the secondary. The action of the coil D allows a considerable reduction in the section of the coil B, as it may be said to carry part of the active induced current. It can be made of considerable cross-section and of heavy metal with impunity. This allows the use of a metal of zero temperature coefficient and thereby greatly reduces the temperature coefficient of the meter.

The vane E, which is a part of the coil stamping, is adjusted to swing freely and with a large amount of clearance between the poles of a strong permanent magnet F, which acts as a dampener on the oscillations of the moving element but does not cause any friction or in the least affect the accuracy of the calibration. This magnet is not affected by the action of the alternating flux as it is mounted in a position where there is very little leakage, the magnetic density in the core being exceedingly low.

The primary principle upon which this meter operates, that which produces the torque, is known as electro-magnetic repulsion. This principle was first explained by Professor Elihu Thomson ("Novel Phenomena of Alternating Current," Transactions American Institute of Electrical Engineers, Vol. 4, page 160). If a closed circuit coil is held in an alternating magnetic field and is threaded by the lines of force, a current will be set up in the coil which will cause it to experience a force that will tend to move it and which is proportional in magnitude and direction to the product of the corresponding instantaneous values of current and magnetism, and the force for one cycle is equal to the average instantaneous torques during the period.

In the case at hand, a flat disc or one-turn coil inclosing an iron core, the coil will have a considerable self-inductance. The effect of the self-inductance is to cause the induced current to lag behind the induced pressure; the induced pressure being ninety degrees in phase behind the magnetism. In this case the instantaneous values of force, when plotted in a curve, will give a larger negative than positive value and the result will be a repulsive action. With reference to Fig. 4 it is seen that the induced current and magnetism act in opposite directions, most of the time, when they have a difference of phase of 90° + 45°; the distance represented by A is attractive and by B repulsive, and the dotted lines represent power loops, the downward being negative or repulsive.

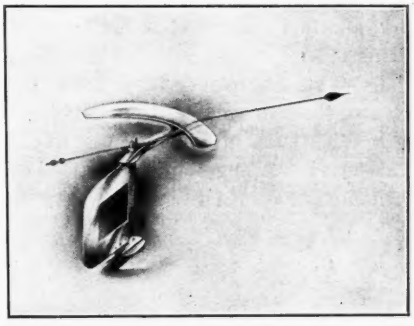


FIG. 2.—MOVING ELEMENT OF THE REPULSION METER.

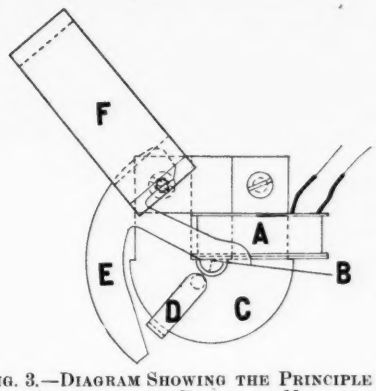


FIG. 3.—DIAGRAM SHOWING THE PRINCIPLE OF ACTION OF THE REPULSION METER.

Had there been no self-inductance to the coil the induced current would have been only ninety degrees out of phase with the magnetism and the resultant force during the period would have been zero.

An alternating current is also induced in the supplementary secondary circuit, which is practically in the same phase as the current in the movable secondary and the magnetic leakage flux of the first threads the second in the proper way to cause an attractive effect, which tends to increase the movement produced by the repulsive effect of the primary.

Should a measuring instrument having a dynamic action be subjected to two currents of different frequency, there would be a greater impedance drop at the higher frequency without any change in exciting current. In the case of a "repulsion" meter this condition is changed. A change in frequency causes a change in exciting current and the impedance drop will be greater or less depending upon the amount of resistance and reactance in the circuit. The following explanation should make this clear:

It is a well-known fact that the hysteresis loss in an iron core is proportional to the frequency and also to the 1.2 to 1.6 power of the induction. In the "repulsion" meter, it being virtually a short-circuited transformer, the induction is nearly inversely proportional to the frequency. Consequently, the hysteresis loss would vary somewhere between the 0.2 and 0.6 power of the induction. The foucault current loss, only, remains to be considered and it varies as the square of both the frequency and the induction, and as these quantities are inversely proportional, the foucault current losses would not change upon change of frequency, except a small amount caused by the leakage induction. So the only change in the current due to core or iron losses would be a small amount caused by the hysteresis loss, and as the induction in the iron decreases there would be a small proportional decrease in exciting current in a change to a higher frequency, the voltage or deflection remaining constant.

The magnetizing current also changes with a change in frequency and is a variable because of the change in the permeability due to changes in magnetic density. Now both the magnetizing and hysteresis components of the exciting current cause a decrease in the primary current at higher frequency and *vice versa,* and this change between thirty and sixty cycles is approximately three and one-half per cent of the total current (see Fig. 6, lower curve). This condition would, of course, cause a relative error in either a current or voltage-measuring instrument, but for the compensating effect of other features.

Because of the demagnetizing effect of the secondaries and also because of the extreme narrowness of the coils along the core, and their position relative to each other, a considerable magnetic leakage field is produced between them. This has

the effect of giving the coils a large self-inductance and the greater the deflection of the coil the greater this effect. This feature makes possible the compensation of this design of meter. That is, the compensation is accomplished, in the case of a voltmeter, when the fall of potential across the meter or the change in current is practically independent of the current frequency within wide limits.

Let us first consider the case of a voltmeter. The self-induction of the coils

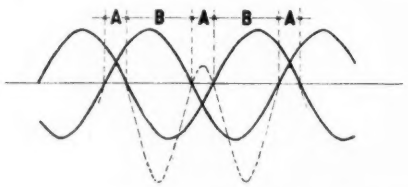


FIG. 4.—DIAGRAM SHOWING THE PHASE RELATIONS OF THE INDUCED CURRENT AND MAGNETISM IN THE REPULSION METER.

upon this "closed-circuit" iron core tends to cause a smaller deflection of the needle at a higher frequency because of the increased reactance of the primary, but there is also a decrease in the current required to excite the iron and maintain the previous deflection; consequently a decrease in the resistance drop. Now by properly proportioning the resistance and reactance, the fall of potential over each, due to the current, may be made to vary in the proper inverse ratio, and the resulting impedance will be such that the fall

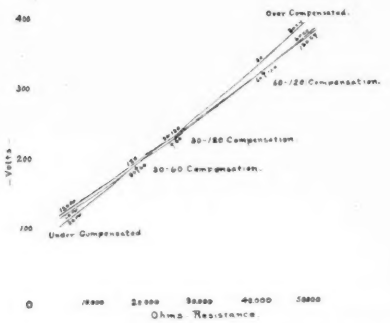


FIG. 5.—DIAGRAM SHOWING THE EFFECT OF ADDING RESISTANCE TO AN UNDER COMPENSATED REPULSION METER.

of potential across the meter will be practically independent of the change in current frequency.

The curve (Fig. 5) shows the effect of adding resistance to an "under-compensated" meter until it is "over-compensated." At the crossing of the curves compensation is effected. The slope of the curves being nearly the same, a large change in resistance makes only a small change, either voltage or degree of compensation. This compensation is exact for any two frequencies as selected, but will not be for all frequencies, as shown in the cut (Fig. 5). The error, however, in a properly compensated meter is small, as will be evident from the curve (Fig. 6) showing a change of 500 per cent in the frequency, while the maximum full-scale error is only one-half per cent and the total change of voltage one per cent. This is for practical purposes negligible and is especially good for alternating-current work, all other features considered.

This change in the value of full-scale voltage at various frequencies is due to the CR and reactive voltage drop not varying in exactly the inverse ratio due to the forementioned changes in current. The self-induction or reactive drop varies as

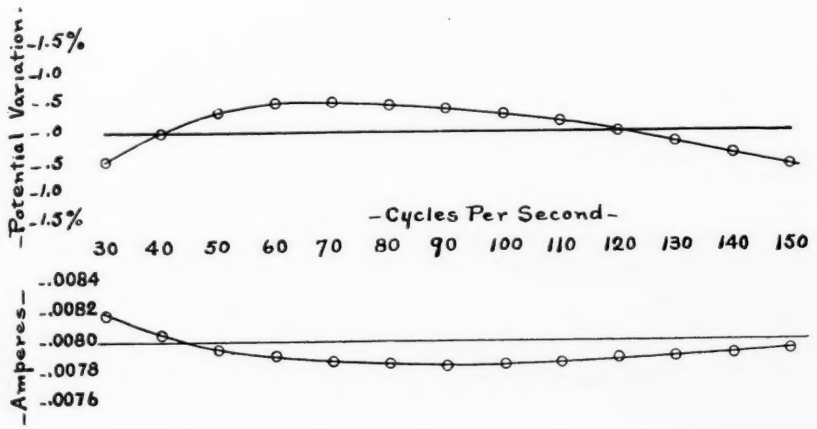


FIG. 6.—CURVES SHOWING THE EFFECT OF VARIATION IN FREQUENCY ON REPULSION METER.

the frequency, while the CR or resistance drop varies direct as the current, which does not vary exactly as the frequency (see Fig. 6, lower curve); consequently, at the lower frequencies the CR increases faster than the reactive drop decreases, while at the higher the current is nearly constant, making the CR drop constant while the reactive drop increases. Therefore the impedance of the meter is greater at both thirty and 150 than it is at sixty cycles, due to the CR drop varying too much or too little to take care of all the changes in reactance. The error thus caused is not serious, as shown above.

The compensation of ammeters like that of voltmeters is accomplished by proportioning the ratio of the CR drop to the self-inductive drop, but in the case of the ammeter the pressure across the meter must increase the proper amount at a higher frequency to cause an increase in the current in a shunt across the primary coil just sufficient to make up for the decrease in current in the primary. The shunt may be wound inductively or otherwise with practically the same effect. The range of error due to changes in frequency is about the same as in the case of the voltmeter.

The best forms of alternating-current ammeters of other designs consume about nine watts at full-scale deflection, while the ammeter just described needs approximately one watt.

Changes in the wave form of the primary current have no appreciable effect on the indication of this meter, as the greatest possible change, caused by change in wave form, is only four or five per cent of the core loss, while the probable change is much less, and beside this the core loss is only a very small part of the total power required to overcome the C^2R loss in the coils and other losses.

The "repulsion" type of induction meter, herein described, has a power-factor of sixty to seventy per cent, and as the reactance is not affected by temperature changes, the meter is inherently less affected by this cause. There are three additional provisions made to eliminate this effect in both ammeters and voltmeters. As previously mentioned, an adjustable secondary, having an attractive action upon the moving element, is composed of metal having a zero temperature coefficient, and so far as this coil in itself is concerned there will be no change of current in it due to changes in surrounding air temperature or "current heat," and it is evident that its action will to a large extent compensate for the change in the resistance of aluminum moving element. This action is not of itself sufficient to entirely eliminate the error, however, and a closed coil composed of a wire of very high temperature coefficient is wound upon

the core directly underneath the primary, and the ampere turns of this coil will act directly as back ampere turns on the primary. Now let the air or room temperature rise and the resistance of this secondary increases rapidly, decreasing the current in it and giving a greater proportion of power to the primary, which will compensate for the greater power required to supply the increased C^2R loss in the other coils, due to the increase in resistance at the higher temperature. The effect of this coil with a certain number of turns and resistance may be adjusted to the proper condition by varying the resistance in circuit with it. It is desirable to make this coil not too strong, except in special cases, as it directly increases the power necessary to operate the meter, so a further provision is made to help take care of the changes in resistance of the copper primary. In the case of a voltmeter the series resistance is composed of a metal which has a zero temperature coefficient. A considerable amount of this resistance wire in series with the primary makes the CR drop across the primary, which changes due to temperature, so small as compared with the CR drop across the series resistance and reactance drop of the primary, which do not change, that this change in resistance is negligible and the voltmeter will be independent of temperature changes.

The same effect is accomplished in the case of the ammeter by making the shunt of the same metal as the coil, and as the resistance across the coil increases the resistance of the shunt increases the same amount, increasing the voltage supplied to the coil the proper amount, and the temperature compensation is thereby effected.

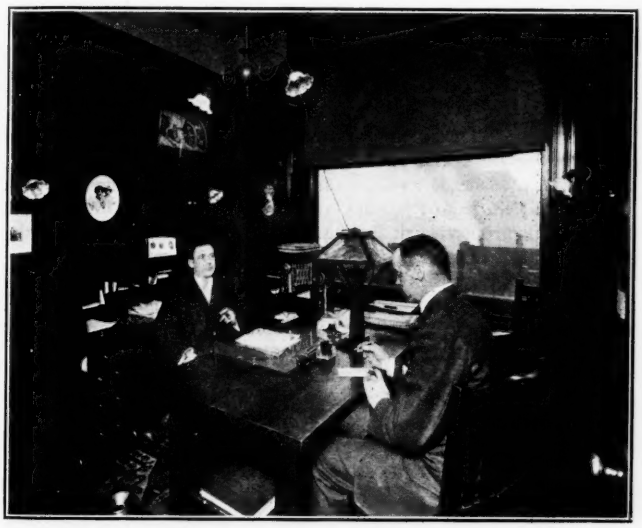
The instruments with which the readings for the results shown were taken are the best and most complete for the purpose. All are standardizing instruments of the highest sensibility, and correct within their working range to one-twenty-fifth of one per cent at all frequencies and wave-forms. The instruments referred to are the "comparator," used in connection with a potentiometer, together with the proper standard shunts, resistances, etc., made by the Leeds & Northrup Company, of Philadelphia, and need not be further described here. The frequency was kept very constant at all readings by the proper use of a cone pulley and two synchronous motors belted together and each run as a generator or motor, as the case required, from a circuit of constant frequency. The results given are also obtained regularly and are representative of a large number of tests made by the writer and assistants during the past several months.

The Dallas Securities Company.

The securities of the Bonham Electric and Gas Company, Bonham, Tex.; Cleburne Electric and Gas Company, Cleburne, Tex.; Dublin Electric and Gas Company, Dublin, Tex.; Hillsboro Electric and Gas Company, Hillsboro, Tex.; Sherman Electric and Gas Company, Sherman, Tex., and the Waxahachie Electric and Gas Company, Waxahachie, Tex., which have been controlled by the Dallas Securities Company, of Dallas, Tex., have had their management transferred to the J. F. Strickland Company, Dallas, Tex. This company is acting as manager for the above properties. The company consists of J. F. Strickland, chairman; M. B. Templeton, vice-chairman; O. Goodwin, treasurer; J. D. Caldwell, secretary, and R. B. Stichter, general superintendent. Mr. Stichter is also purchasing agent for the company.

The Arthur Jones Company.

One of the most popular companies in Chicago, Ill., acting as manufacturers' agents and making a specialty of repairing motors and generators is the Arthur Jones Company, with large offices in the Old Colony Building. The company carries a large line of alternating and direct-current motors bearing the name of the president, Arthur Jones, as its type designation. The company makes a specialty of the application of motors for machine-tool driving, and has installed its apparatus in a number of the prominent buildings in Chicago. Among these may be mentioned the following: the H. N. May electric light plant, of the city of Chicago, a 750-kilowatt, 6,600-volt, three-phase, sixty-cycle, engine-type alternator; E. L. Mansure Company, 100 motors driving looms and knitting machines; Barnes-Crosby Company, twenty-three motors driving engraving machinery; Juergens & Anderson, twenty-seven motors driving jewelers' machinery; Chicago *Evening Post*, motors driving trimming machines; R. J. Ederer Company, thirty motors driving fish-net knitting machines; Marshall Field & Company, fifteen motors driving laundry machines; Lewis Institute, seventeen motors driving machine tools; Crane Company, twenty motors driving machine tools.



THE OFFICES OF THE ARTHUR JONES COMPANY, OLD COLONY BUILDING, CHICAGO, ILL.

Current Electrical News

DOMESTIC AND EXPORT.

TELEPHONE LINES FOR CHINA—Active construction work has been begun on the government telephone lines which are to connect Amoy with Tsun Cheu Fu, fifty miles to the north, and Chang Chou Fu, thirty miles to the west.

MARCONI RECORD BEATEN—The Wireless Spark Telegraph Company asserts that it has made a record in transmitting messages for 2,290 miles, between Hauen, near Berlin, Germany, and the Hamburg-American Line steamer Cape Blanco, off Teneriffe, Canary Islands. This is about 300 miles further than the distance traversed by the Marconi transatlantic wireless messages.

NEW ARIZONA POWER COMPANY—The Arizona Power Company is to develop a water power in the Fossil Creek Falls, fifty miles from Prescott, Ariz., and transmit electricity to a central station near Prescott and distribute it to the various small towns and mines throughout the county. The falls themselves have an estimated horse-power of 6,000. It is stated that the company has been financed by Bonright & Company, of New York, to the extent of $1,500,000.

BELL TELEPHONE SALE RATIFIED—At a special meeting of stockholders of the Bell Telephone Company of Canada, held January 10, the sale of the company's lines, buildings, equipment and all other assets contained in the province of Quebec for the sum of $3,400,000 was ratified. C. F. Sise, president, stated that he considered the bargain a good one for the company as some important reservations were made, for instance, the Bell company had the right to operate lines over the province connecting Saskatchewan and Ontario and to connect with the Manitoba government lines on through business. The $3,000,000 worth of forty-year 4-per-cent bonds which the company will receive from the province will constitute a trust fund, which can be utilized to pay for improvements to the company's present system.

KANSAS ELECTRIC ROAD TO BE BUILT—F. V. Crouch, president of the Kansas Southern Electric Railway Company, which proposes to build an electric railway northwest from Pittsburg, Kan., has received word from Paris that the French capitalists who were to finance the project have approved the loan, and work of construction will start in the spring. A deal for a five-million-dollar loan has been closed. The new Crouch line will start from Pittsburg, passing through Dunkirk and Radley and other new coal camps northwest of Pittsburg. The line will run straight to Girard, thence west through the county to St. Paul, Erie, Chanute and Iola. Right of way has been secured for most of the route, and the county commissioners have granted a franchise for the crossing of the county roads.

PHILADELPHIA FINANCIERS TO BACK ELEVATED RAPID TRANSIT PLAN FOR CINCINNATI, OHIO—Traction interests of Randall Morgan, of Philadelphia, represented in Cincinnati, Ohio, by W. Kelsey Schoepf, will finance the proposed rapid transit railway in Cincinnati, a $4,000,000 project which J. G. Schmidlapp has been fostering for several years. This announcement was made at the City Club by Judge Rufus R. Smith, who represents Schmidlapp in the movement to secure the passage of a state law to enable the elevated traction project to work on the same basis as a surface or steam road. All the plans for the proposed elevated road were laid out years ago, but no steps toward securing a franchise were taken because financial backing was lacking. Schmidlapp and Schoepf recently had a conference with Morgan and his associates in Philadelphia, where the details of the project were gone over and the cases assured. Philadelphia capitalists also are interested in the Cincinnati Traction Company.

THE CHICAGO & MILWAUKEE ELECTRIC RECEIVERSHIP—On the application of an owner of twenty-five shares of the Chicago & Milwaukee Electric Railroad Company Circuit Judge Tuthill, on December 31, appointed three receivers for the company and officers of the court took possession of the corporation's offices in the Stock Exchange Building. The company was not charged as being insolvent, the money being in the bank to pay the January interest on the $15,000,000 bonds. The receivership proceedings, involving about $30,000,000, were brought by Edgar H. Tolman on behalf of Charles J. Monahan, who owns the twenty-five shares, worth probably $2,500, who charges President A. C. Frost with fraud in the manipulation of stocks and bonds of the various companies which he controls. As the result of formal legal steps to end the receivership, taken before Judge Tuthill, an order of vacation was issued by the Court, and the bond of $50,000 of Gordon Ramsay, the only receiver who qualified, was canceled, and Mr. Frost resumed the presidency of the system. Meanwhile Mr. Frost has turned over his stock interests in various companies to Charles G. Dawes, president of the Central Trust Company, as trustee. For the present the trustee will safeguard Mr. Frost's interests and those he represents.

COLORADO ELECTRIC MERGER—Joseph J. Henry, of Denver, Col., who a little more than a year ago raised $3,000,000 cash to carry out the plans of the Northern Colorado Power Company, has closed a deal for the purchase of the gas plant and two electric companies with their street railway and interurban railway holdings at Trinidad, Col., and is preparing plans for the extension of the power lines and railroads which will mean an expenditure of more than $5,000,000 within the next few years. "The syndicate with which I am connected has already spent a half million dollars in acquiring properties at Trinidad," says Mr. Henry, "and in the course of time will spend from $5,000,000 to $10,000,000 in improving and extending the lines—power and railway. The situation is analogous to that of the Northern Colorado Power Company, organized to take over the electric plants in the northern part of Colorado." A short time ago Mr. Henry and a syndicate of capitalists formed the Southern Colorado Power and Railway Company, which has purchased the Trinidad Electric Railway Company, the Trinidad Light and Power Company and the Stonewall Valley Electric Railway Company. These companies owned the gas plant, two electric plants, and the street and interurban lines at Trinidad. There are twenty-five miles of standard gauge lines in operation. The company is now building an electric railway line to Cokedale, the coke camp of the American Smelting and Refining Company, and will build thirty miles of line to the coal mines being opened up by Senator Clark at Stonewall. Senator Clark will ship 1,000 tons of coal a day to his smelters at Jerome, Ariz. Electric roads will be built to nearly all of the towns in the vicinity of Trinidad, and the company will also build power lines to all of the towns. It will probably extend its lines to La Junta. The Southern Colorado Power and Railway Company is a preliminary company which was formed to take over the properties that have been purchased. Mr. Henry says that the proposition offers an opportunity for the steam railroads to electrify their lines. There are four railroads in Trinidad. The Santa Fé railway at the present time uses three engines to carry freight trains over the Raton Pass and two engines on every passenger train.

LEGAL NOTE.

NEW YORK STATE TO SUE TROLLEY ROAD—State Engineer Skene has asked Attorney-General Jackson to proceed in court against the White Plains & Mamaroneck Railroad Company to prevent its operation of a trolley line extending seven miles from Tarrytown to White Plains. The state engineer says the railroad failed to get the consent of the state to operate the road. The new highway law provides that before a railroad may be built legally along a road which has been improved by the state under the good-roads act or which is about to be improved by the state, the consent of the state engineer must be obtained. It is said that the new line is built on one of the so-called state roads, the switches reaching into the macadam. The road is operated by the Union Railway interests.

ELECTRIC LIGHTING.

FORT FAIRFIELD, ME.—The Fort Fairfield Electric Light plant at Stevensville has been destroyed by fire.

NORTHWOOD, IOWA—C. H. Walker, owner of a water power on the Shell Rock river, has applied for an electric lighting franchise.

WILKESBARRE, PA.—Plans are now under way for the construction of an electric-light plant which ultimately will carry current to the towns of Shavertown and Trucksville.

MONSON, ME.—The contract for the installation of the lighting plant of the Monson Light and Power Company has been awarded to Ernest D. Blaisdell, and work will be commenced as soon as possible.

ELMA, IOWA—The municipal light plant at Elma burned on December 30. The plant was erected about ten years ago. A new dynamo was installed two months ago. The loss is $6,000, and the insurance, $2,000.

FARMINGTON, MO.—Farmington will vote on January 28 on a proposition to issue bonds to the amount of $25,000 for the installation of an electric light and power plant to be operated in connection with the waterworks system. C. M. Thomsen is waterworks engineer.

ALBANY, N. Y.—The Schaghticoke Electric Company has filed with the secretary of state a certificate increasing its capital stock from $30,000 to $500,000. Among those interested as stockholders are: George E. Greene, H. R. Leyden, Frank H. White, Irving E. Gibson and Edwin H. Libby.

EDGEWOOD, GA.—Current has been turned on at the new municipal electric lighting plant at Edgewood. Forty odd arc lights and sixty high-power incandescent lights have been installed. Several months ago Edgewood issued bonds to the amount of $15,000, since which time the plant has been in course of construction.

OROVILLE, CAL.—A. B. Bidwell, of Greenville, who is superintendent of the Meadow division of the Great Western Power Company's property, has commenced the work of obtaining rights of way for a pole line for the transmission of power. The Meadow division includes all the rights and property of the Great Western Power Company in the vicinity of Prattville, Plumas county.

SALISBURY, N. C.—Everything is in readiness at Whitney for the resumption of operations on the power plant being developed at that place by the Whitney Reduction Company, of Pittsburg. It is announced that the electric plant, with a capacity of 45,000 horse-power, will be in readiness for service by March 1 of this year. A. J. Gillespie, of Pittsburg, is the contractor on the work.

FAYETTEVILLE, N. C.—A careful survey has been made of the Cape Fear river for two or three miles below Buckhorn Falls and the engineers report to the Phœnix Construction Company (as the Cape Fear Electric Power Company is now named) that 18,000 horse-power is available by development, besides the 4,000 now generated. The local cotton mills have installed extensive electrical machinery in readiness for the Buckhorn power.

MEMPHIS, TENN.—Henry C. Brent has been appointed receiver of the Citizens' Electric Company of Eureka Springs, Ark., which embraces the electric lighting plant, the street railway and other important interests in that town. The application for the appointment of a receiver came from the Kansas City Trust and Fidelity Company of Kansas City, Mo., and the receiver is vice-president of that institution, which holds $107,000 of the paper of the company.

BEATRICE, NEB.—In the District Court Judge Kelligar confirmed the sale of the plant of the Wabaska Electric Company at Blue Springs and ordered Receiver Marvin to use the first money realized from the sale to pay the taxes against the company, which amount to about $2,200. The only bid made in the sale was $1,400, which was offered by C. A. Snyder, manager of the electric plant at Auburn. He will dismantle the plant and remove it from its present location in Blue Springs.

OAKLAND, CAL.—An entire block in East Oakland has been purchased for a substation by the Western Power Company. The site will be used for the erection of a substation at the end of the high-tension line to be run from the Big Bend plant on the Feather river. The plant will be part of the general plan for the transmission of electric power from the mountain valleys to the bay cities. Work on the substation will be commenced soon and plans for the structure and equipment are well under way. A main steam-plant auxiliary of 30,000 horse-power is to be erected at Sessions basin.

GRAND HAVEN, MICH.—Grand Haven is considering the abandonment of its municipal electric lighting plant and entering into a contract with the Grand Rapids-Muskegon Power Company for its electricity. Grand Haven has for ten years had a municipal lighting plant, but the service the last several years has been very poor. The council some weeks ago voted for the expenditure of $15,000 for the enlargement and rebuilding of the plant. Mayor Corl, however, vetoed the action of the council. A committee of citizens has been appointed to cooperate with the city council and to investigate and report as to what would be the best thing for the town to do.

NORTHFIELD, MASS.—The Connecticut River Power Company, which is constructing a large dam between Vernon and Hinsdale, has announced its plans for a further development of power at the French King rapids on the Connecticut river, a short distance above Turners Falls. The company proposes to erect, within the next two or three years, or after completion of the dam at Vernon, a low dam at the head of the French King rapids that will have a height of from ten to twelve feet in times of low water, but will at no time raise the water above the present banks of the river. The purpose of this dam is not to develop year-round power, but simply to generate energy during low-water periods.

DETROIT, MICH.—After buying out the Trenton electric lighting plant and waterworks, the Washtenaw Light and Power Company, a branch of the Edison Illuminating Company, has secured from the Monguagon township board a thirty-year franchise which gives it the right to run electric feed lines into the township over any route desired, and which eventually will give the residents of Grosse Isle an electric light service, it is said. In the township the lighting rates are to be the same as prevail in Detroit, while the contract given by Trenton several weeks ago fixes the same rates that were in force under the municipal lighting system. The company intends to bring feed wires over a route from Ypsilanti. Villages along the line will also be supplied with power and lighting service.

NIAGARA FALLS, ONTARIO—The authorities of Niagara Falls have granted to the Ontario Distributing Company a valuable franchise right which permits it to do a general electric light and power business in the entire township. The franchise gives the company the right of entrance to all parts of the township, including St. Davids and Queenston villages, as well as access to all canning factories, quarries, cement mills and other industries located in those places and between them. This same company recently secured a franchise from the Stamford township together with a contract to light certain streets of that municipality, and it is now building its transmission lines from the Ontario Power Company's transforming station northward through the south end of the city and Stamford village to the county line.

DATES AHEAD.

Chicago Electrical Show. Coliseum, Chicago, January 13-25.

International Independent Telephone Association. Annual meeting, Chicago, Ill., January 21, 22 and 23.

Nebraska Independent Telephone Association. Next meeting, Omaha, Neb., January.

Ohio Independent Telephone Association. Next meeting, Columbus, Ohio, March 19.

ENGINEERING SOCIETY NOTE.

THE ENGINEERS' CLUB OF PHILADELPHIA HOUSE-WARMING—The Engineers' Club of Philadelphia held a reception and house-warming in celebration of the opening of its new club house and the thirtieth anniversary of the club, on the evening of Saturday, January 11.

NEW MANUFACTURING COMPANY.

TRENTON, N. J.—The Paragon Electric Company, of Camden, has been incorporated with a capital of $125,000 to manufacture electrical appliances. The incorporators are: W. E. Groves, H. Warren Caster and William B. MacDonald.

TELEPHONE AND TELEGRAPH.

EL DORADO, ARK.—Blain & Ritchie have purchased the plant of the Home Telephone Company at El Dorado.

NAUGATUCK, CT.—The Southern New England Telephone Company has cut over its plant to the common battery system.

LEWISTON, ME.—The East Hebron Telephone Company has completed and placed in operation its line from South Buckfield to Hebron by way of East Hebron.

FORKTOWN, PA.—The Bell Telephone Company is erecting a line from Nuremburg through Zion's Grove. This will be of great benefit to the farmers throughout the district.

WORCESTER, MASS.—The telephone exchanges of Uxbridge, Whitesville and East Douglass, which have been independent since they were installed, have been made a part of the Worcester exchange.

ROCHESTER, N. Y.—A third exchange is to be erected on Genesee street by the Bell Telephone Company, according to a statement by District Manager Alvin H. Dewey. The site for the building has already been purchased and plans for the building are being made, but construction will probably not be started before spring. In its main features the building will be similar to the Chase exchange on Park avenue. Growing business makes the third exchange a necessity.

HOUSTON, TEX.—Arrangements have been completed whereby Reid & Slusher, representing the Home Telephone Company, will purchase a lot belonging to Messrs. F. E. Pye and Mark Weiss, located on San Jacinto street, between Capitol and Texas avenues. The telephone company proposes to erect a modern three-story brick structure, fireproof and otherwise complete in every detail. The plans of the building have been completed and work will be commenced in the near future.

SAN DIEGO, CAL.—Certified copies of the articles of incorporation for the Sunset Telephone and Telegraph Company and for the Pacific Telephone and Telegraph Company have been filed. The Pacific Telephone and Telegraph Company was organized several months ago and these papers are copies of the original filed with the secretary of state. The Pacific company was organized with a capitalization of $50,000,000 and embodies the two old companies, the Sunset and the Pacific States, which formerly were practically two companies working under one head.

SAN BERNARDINO, CAL.—The possibilities of a telephone line from Redlands to Imperial, by way of San Jacinto and Idyllwild, are shaping up as the construction work of the Southwestern Home Telephone Company progresses. The company was reorganized last summer by Redlands and San Jacinto capitalists, and has now completed its line to Oak Grove, thirty-five miles southeast of San Jacinto, and touches San Jacinto, Winchester and Idyllwild, the latter point being about 6,000 feet above sea level. This line also connects with the Keen Camp and the Thomas ranch, in the San Jacinto mountains.

GREAT FALLS, MONT.—Attorney George H. Stanton, counsel for the Montana Independent Telephone Company, states that the company will endeavor to complete the construction of its long-distance line between Butte and Great Falls in the early spring. The Independent company will also, in all probability, commence the establishment of a local exchange in the spring. The company is completing the establishment of its exchange at Anaconda, while that at Butte is working and giving good satisfaction. In Butte, the company has 2,500 telephones installed, while orders for 600 instruments are being filled as rapidly as possible. The company uses the automatic system.

WATERVILLE, N. Y.—Parks Terry has sold a controlling interest in the Waterville Telephone Company, a stock concern, to Walter Bishop, of this village. Mr. Bishop will become treasurer of the company and Mr. Terry will act as general manager. When Mr. Terry became owner of the telephone system of this village, it had thirty telephones. It now has 250 and has branches in Deansboro, Hubbardsville, and all the surrounding towns, as well as outside connections. For a number of years the business has paid nine per cent and for the past nine months, beginning March last, the earnings have been 10.9 per cent. The officers of the company are: I. D. Brainerd, president; H. M. King, secretary; S. S. Bissell, vice-president; Walter Bishop, treasurer; W. G. McLean and S. W. Goodwin, directors, and Parks Terry, general manager.

INDEPENDENCE, KAN.—Farmers of the vicinity of White Post in this county are determined to have a telephone route. At a recent meeting a number of resident farmers agreed to form the nucleus of a telephone company by putting telephones in their houses and each building his mile of private line. Jefferson and Lafountain, where mutual telephone companies have already been organized, were represented, and wanted to join in with White Post and form a strong organization covering a large territory and having Independence for the objective point of their lines. They will control their own line and expect to merge all the farmers' mutuals in this section of the county into one company.

NEW PUBLICATIONS.

THE ENGINEERING DIGEST—A more or less general misapprehension by technical readers as to the nature of the contents of "Technical Literature," as described by that title, has made a change of name advisable. The magazine is an engineering publication and compendium of published information on technical subjects. After careful consideration the title has been changed to the "Engineering Digest," as most clearly defining the nature of the publication. One other change—The "Index," now known as the "Index to Technical Articles in Current Periodical Publications," will be called the "Technical Press Index." The publication is issued every month by the Technical Literature Company, New York city.

APPROVED ELECTRICAL FITTINGS—The October, 1907, edition of "Electrocraft Illustrated List of Approved Electrical Fittings and Revised National Electrical Code" is ready for distribution. This contains a list of fittings that have been examined and approved by the Underwriters' National Electric Association for use under the rules and regulations of the National Board of Fire Underwriters. A feature which makes this edition very valuable to the contractor and wireman is the revised National Electrical Code, in which many illustrations are given indicating the strict interpretation of the approved rules. The list is compiled and published by the Electrocraft Publishing Company, Detroit, Mich., and retails at fifty cents.

NEW INCORPORATIONS.

DAVIS, ILL.—People's Mutual Telephone Company. Capital increased from $10,000 to $15,000.

FAIRMONT, W. VA.—The Watson Company. $160,000. To own and operate electric light plants, glass plants and other manufacturing industries. Incorporators: S. L. Watson, A. B. Fleming, J. E. Watson, C. W. Watson and Brooks Fleming.

DOVER, DEL.—Automatic Home Telephone Company. $200,000. Incorporators: I. A. Morrison, S. E. Morrison, Ray Blaisdell, A. J. Vernier, Frederick G. White, C. R. Tombaugh, H. S. Allen, A. F. Meete, E. B. Kipp, Pontiac, Ill.; Charles F. Branson, Cadiz, Ohio.

INDIANAPOLIS, IND.—Sullivan Electric Light and Power Company and the Sullivan Heat, Light and Power Company; merged, with the name of the Sullivan Lighting Company. $50,000. Directors: A. S. Courtright, W. H. Hayes, A. E. Hazelrig, L. A. Stewart and F. S. Donnell.

OBITUARY NOTES.

MR. GEORGE H. REYNOLDS, formerly a leading mechanical engineer and authority on gun construction, died on January 3 in Mansfield, Ct., aged seventy-nine years. Mr. Reynolds was connected with many large constructing firms in Connecticut and New York, and was responsible for improvements in passenger elevators.

MR. JOSEPH W. CLARKE, treasurer of the Consolidated Gas, Electric Light and Power Company, Baltimore, Md., died suddenly on December 31. Mr. Clarke was born in Richmond, Va., in 1845, and was the son of the late Henry and Mary Maule Clarke. He was one of the oldest employés of the company, having been in the service of the firm in various capacities for the last thirty years. He is survived by a widow, who was Miss Mary Millikin, and one daughter. The body was interred in Greenmount Cemetery on January 2, many representatives of the Consolidated company being present.

PERSONAL MENTION.

MR. HERMAN GAMPER has been appointed superintendent of the Columbus (Ohio) municipal electric-light plant, succeeding M. M. Reid.

MR. OSCAR C. TURNER has retired as general manager of the Southern Electrical Company, Nashville, Tenn., to become identified with the Warren Electric and Specialty Company, of Warren, Ohio. He is succeeded by Harry E. Dyer.

MR. C. C. BAIRD, for several years with the H. B. Camp Company's New York office, severed his connection with that company on January 1, to accept the position of sales representative for the McRoy Clay Works, Rookery Building, Chicago, Ill.

MR. JAMES H. FORSYTHE, for eighteen years with the United Electric Light Company, of Springfield, Mass., has been appointed manager of the Chicopee (Mass.) municipal electric-light plant, succeeding George E. Stebbins, who has been at the head of the plant some years. Mr. Stebbins relinquished control of the plant on January 15.

MR. H. M. LAURITZEN, of the engineering department of the Holophane Company, is in the West, chiefly in the interest of his company, but partly also to recuperate from a recent illness. Mr. Lauritzen will remain several months in Flag Staff, Ariz., returning to New York *via* Mexico City, where he will assist the Holophane Company's representative, Victor M. Braschi & Company, in handling a number of important lighting installations.

MR. GEORGE McLEOD, formerly chief engineer of the Lexington Railway Company, the Central Kentucky Traction Company and the Blue Grass Traction Company, has been made superintendent of railways for the system. J. R. Pope has been appointed chief electrical and mechanical engineer; G. W. Brown, master mechanic; J. P. McKeever, superintendent Lexington power station, and C. K. Morrell, superintendent of the light and gas departments.

MR. F. A. SCHROEDER, assistant to Alfred Clarke, president of the Boston Heat, Light and Power Company, and head of the Leominster and Clinton lighting establishments, has succeeded Fred L. Fullam as general manager. Mr. Schroeder is to make his headquarters in Leominster, in order to look after the Leominster and Clinton, as well as the Ayer plant, owned by the company. Francis S. Thayer, with an experience of twenty years in electrical work and gas making, has succeeded John F. Madden as superintendent of the Clinton Gaslight Company. His supervision extends over the gas and electrical plants in Clinton.

MESSRS. GEORGE T. HANCHETT, W. T. MANNING AND W. D. YOUNG announce the formation of the engineering firm of Manning, Hanchett & Young, consulting mechanical, civil and electrical engineers, with offices at New York and Baltimore. Mr. Manning is a graduate of Glenwood Institute, Maryland, and has had a wide experience with city engineering departments and some of the largest railroad organizations. Mr. Hanchett is a graduate of the Massachusetts Institute of Technology, and has been identified in a responsible capacity with a number of important electrical companies. Mr. Young is a graduate of Cornell University, and has been associated with electrical and civil engineering undertakings for the past fifteen years.

ELECTRICAL SECURITIES.

Many advances were registered last week as a result of the development of considerable strength in the market. The increasing ease in the monetary situation is credited with the improved showing. A larger investment demand also had a tendency to swell operations, and had much to do with the week's million-share day, the first since early in December. The bank statement for the week showed that the bank deficit had been wiped out and that a good surplus was on hand. It is now thought the monetary and banking conditions have returned to normal, and that further apprehension on this score is unfounded.

Dividends have been declared upon the following electrical securities: Omaha Electric Light and Power Company; regular semi-annual dividend of 2½ per cent, payable February 1 to stock of record January 20. Cincinnati, Newport & Covington Light and Traction Company; regular quarterly dividends of ¾ of 1 per cent on the common stock and 1½ per cent on the preferred stock, payable January 15. East St. Louis & Suburban Company; regular quarterly dividend of 1¼ per cent upon the preferred stock, payable February 1 to stock of record January 15. Milwaukee Electric Railway and Light Company; quarterly dividend of 1½ per cent, payable January 31 to stock of record January 20. Columbus Railway Company; regular quarterly dividend of 1¼ per cent, payable February 1, as registered January 15. Michigan State Telephone Company; regular quarterly dividend of 1½ per cent on the preferred stock, payable February 1. Electric Bond and Share Company; regular quarterly dividend of 1¼ per cent on the preferred stock, payable February 1. Minneapolis General Electric Company; regular semi-annual dividends of $3 per share on the preferred stock and $2 per share on the common stock, payable February 1 to stock of record January 15.

ELECTRICAL SECURITIES FOR THE WEEK ENDED JANUARY 11.

New York:	*Closing.*
Allis-Chalmers common	6⅞
Allis-Chalmers preferred	19¼
Brooklyn Rapid Transit	43¼
Consolidated Gas	105¾
General Electric	120¼
Interborough-Metropolitan common	7¼
Interborough-Metropolitan preferred	21
Kings County Electric	83
Mackay Companies (Postal Telegraph and Cables) common	60
Mackay Companies (Postal Telegraph and Cables) preferred	63½
Manhattan Elevated	122
Metropolitan Street Railway	25
New York & New Jersey Telephone	96
Western Union	55½
Westinghouse Manufacturing Company	45¾

Application has been made to the New York Stock Exchange to list an additional $375,000 5-per-cent, fifty-year first-mortgage bonds of the Brooklyn Rapid Transit Company, due 1945; an additional $1,860,000 first-consolidated mortgage 5-per-cent bonds, due 1941, of the Brooklyn Rapid Transit Company; $3,500,000 first-mortgage 5-per-cent bonds, due 1941, and an additional $629,999 first-consolidated mortgage 5-per-cent bonds, due 1941, of the Brooklyn, Queens County and Suburban Railroad Company.

Boston:	*Closing.*
American Telephone and Telegraph	104½
Edison Electric Illuminating	212
Massachusetts Electric	47¾
New England Telephone	109½
Western Telephone and Telegraph preferred	50

Directors of the Boston Edison Company have declared a regular quarterly dividend of 2½ per cent, payable February 1, to stock of record January 15, 1908. Books do not close.

Net earnings of the American Telephone and Telegraph Company for the eleven months ended November 30, applicable to interest and dividends, were $21,570,000, an increase of $4,746,000, or 28 per cent over the corresponding period of 1906. The balance for dividends after deducting $6,750,000 interest was $14,820,000, which compares with $12,387,000 in the first eleven months of 1906. This is an increase of $2,433,000, or sufficient to have met a full year's dividends on the $21,925,200 stock offered to stockholders in June and have left a balance of $679,000.

Philadelphia:	*Closing.*
Electric Company of America (ex. interest)	8⅝
Electric Storage Battery common	32
Electric Storage Battery preferred	32
Philadelphia Electric	6⅜
Philadelphia Rapid Transit	17⅞
United Gas Improvement	79¼

Chicago:	*Closing.*
Chicago Telephone	111⅝
Commonwealth Edison	85
Metropolitan Elevated preferred	47½
National Carbon common	54
National Carbon preferred	104

The Metropolitan, the South Side and the Northwestern elevated lines last year carried 129,920,737 passengers, or 15,666,910 more than in 1906, which year showed a gain of 7,692,758. The figures for each company are as follows: Metropolitan, 54,280,888; South Side, 40,490,002; Northwestern, 35,149,847.

ELECTRIC RAILWAYS.

HAYWARD, CAL.—The board of town trustees has signed the ordinance which gives the Oakland Traction Company a forty-year franchise for a double-track line over Castro street.

CHAMPAIGN, ILL.—Officers and stockholders in the Kankakee-Champaign interurban company have decided to begin the survey between Champaign and Kankakee and also to take up the work of securing the right of way.

WILMINGTON, DEL.—The West Chester & Wilmington Railway Company will start a preliminary survey at once, and will have cars running on the line by next summer. A Delaware charter will be asked for. The company is capitalized at $54,000.

TERRE HAUTE, IND.—Stringing of the high-tension wires for the Terre Haute, Indianapolis & Eastern interurban line has been completed between this city and the new substation at Brazil. The present power-house in the latter city will be abandoned shortly.

GREENSBORO, N. C.—Dodge & Day, of Philadelphia, have been given the contract to complete the interurban line from High Point to Thomasville, Winston and Greensboro. Work is to be commenced January 20. A part of the line from High Point to Thomasville has already been built.

MANSFIELD, OHIO—The Mansfield Street Railway, Light and Power Company, it is expected, will make extensive improvements to its city lines, as well as the Shelby and Galion lines, during the present year. Manager S. A. Foltz states that it is desired to put the rolling stock in good shape as fast as possible.

BELLEFONTAINE, OHIO—The Ohio Electric Railway Company is building a power-house near Lewistown reservoir for the Bellefontaine-Lima line, now nearly completed, and is erecting a substation near West Liberty for the Bellefontaine-Springfield line, which has been in operation for about two years.

AUBURN, N. Y.—On condition that the Auburn & Syracuse Electric Railway Company pay the city of Auburn $8,000 for the right of way and comply with certain stipulations a franchise has been granted the company to construct a double-track road from Seward avenue to the eastern limits of the city by the common council.

LITTLE ROCK, ARK.—The Little Rock & Pine Bluff Traction Company, which is now building an interurban line from Pine Bluff to Little Rock, may build a branch electric line from the Little Rock-Pine Bluff line to Stuttgart. The company has made a proposition to the town of Stuttgart, and the proposition has been taken under advisement.

HUNTSVILLE, ALA.—The Huntsville Railway, Light and Power Company is receiving large shipments of machinery to be used in a duplicate electric plant. The new machinery is being placed in position as rapidly as possible and it is expected to be in operation by the middle of January. The electric light and car service of this city will be greatly improved when the new plant is in operation.

JEFFERSON, WIS.—Surveys are being made here by employés of the Milwaukee Electric Railway in connection with the proposed extension of that line from Watertown. It is thought President Beggs intends to extend the line from Watertown through Johnson Creek, Jefferson, Fort Atkinson, Whitewater and Palmyra to East Troy and connect with his line there, thus completing the circuit.

MACON, GA.—Superintendent McFarland, of the Macon Railway and Light Company, has announced the intention of the company to improve the facilities for lighting the city and the tracks of the street railway to the extent of $150,000. Of this sum $100,000 will go for mending the tracks and the remainder will be expended on improvements in the power-house, one feature of which will be the installing of a 2,500-horse-power generator.

BLOOMINGTON, ILL.—January 15 was set as the date for the opening of the Lincoln-Mackinaw line of the Bloomington & Normal Railway and Light Company. This is probably the longest electric line in the country which does not touch a town between its two terminal points. The nearest town, Miner, lies three miles to the east while Hopedale lies an equal distance west. The line was built entirely for through passenger and freight traffic.

DETROIT, MICH.—The council of the village of Dundee has granted to Edmund Dill and associates a thirty-year franchise for an electric railway. The track must be laid through the village within three years. The franchise provides for a maximum rate of fare of two cents a mile, minimum fare five cents. If the tracks are laid in paved streets the holders of the franchise must pave between the tracks and eighteen inches outside of the rails, and keep that portion of the pavement in good condition.

ROCHESTER, N. Y.—Over twenty miles of new track were built by the Rochester Railway Company in 1907. In all, the total amount of track laid would cover nearly twenty-three miles. This is the largest amount of construction work done by the railway company in any single season for many years. The greater part of the new track is in extensions, about a mile and a half of it only being in double-tracking lines which formerly had but a single track.

HARTFORD, CT.—The Trolley Express Company, of New Haven, which is one of the subsidiary corporations of the New York, New Haven & Hartford Railroad Company, has filed a preliminary certificate of dissolution by agreement of the stockholders. The certificate states that all claims against the company may be sent to A. S. May, treasurer of the New Haven Railroad. The company was organized to develop and operate an extensive express system in connection with the electric roads controlled by the New Haven system in Connecticut. The plans of the company were subsequently changed and the corporation is now being wound up.

RUTLAND, VT.—A number of extensive improvements and betterments are in contemplation in connection with the public service utilities of Rutland, Vt., operated by the Rutland Railway, Light and Power Company. This company shows net earnings for its railway properties of $47,394.41 for the twelve months ended November 30, 1907. For the gas properties the net earnings were $12,177.83. For the power properties the net earnings were $25,421.94. The earnings of the Rutland City Electric Company were $19,464.41, making the total earnings of the consolidated properties $104,458.59. This property is controlled by G. Tracy Rogers, who also controls the Waverly, Sayre & Athens Traction Company and the Binghamton Railway Company. In a recent interview Mr. Rogers stated that the various trolley and lighting companies in which he was directly or indirectly interested were all in a thrifty, healthy condition, and notwithstanding the stringency of the money market and the consequent depression, are showing marked increases in both gross and net gains. The figures indicated above are an evidence of the truth of this statement.

INDUSTRIAL ITEMS.

THE RYAN CONSTRUCTION COMPANY, 409 Traction Terminal Building, Indianapolis, Ind., has developed an automatic flasher of the solenoid-operated, carbon-contact type.

THE HARVARD ELECTRIC COMPANY, 66 West Van Buren street, Chicago, Ill., announces the Harvard self-welding wire joint. Full information concerning this device will be furnished by the company upon request.

THE SAMSON CORDAGE WORKS, Boston, Mass., is sending to its patrons a convenient desk calendar for 1908. This is ornamented with a sample of Samson "Spot Cord," which is utilized for the suspension of arc lamps and trolley cord.

J. H. BUNNELL & COMPANY, New York city, is distributing folders illustrating and listing Benjamin lighting specialties for series lighting, the Benjamin current tap, and Bunnell telegraphic apparatus. These folders will be sent to those interested upon request.

THE FOSTORIA GLASS SPECIALTY COMPANY, Fostoria, Ohio, has published a handsome calendar bearing a pictorial representation of its process of making its glass specialties, the leaf for each month being embellished also with a phrase indicating the stage of the process illustrated.

DOSSERT & COMPANY, New York city, announces that it has received large orders from the Westinghouse Electric and Manufacturing Company for Dossert solderless terminal lugs, for use on the panels, switchboards and fuse boxes of the enclosed type in the Hudson Terminal Buildings. The M. B. Foster Company has ordered a number of solderless two-way connectors, terminal lugs and cable taps for the wiring of the Singer Building. The

L. K. Comstock Company has ordered solderless cable taps and terminal lugs for the City Investing Building. These buildings are all in New York city.

THE CROCKER WHEELER COMPANY, Ampere, N. J., has ready for distribution the following bulletins: No. 91, descriptive of induction motor panels; No. 92, combined generator and feeder panels for 125-250 volts, direct current; No. 93, small engine-type, direct-current generators; No. 94, alternating-current switchboard panels.

THE GOLDSCHMIDT THERMIT COMPANY, 90 West street, New York city, is distributing a folder describing and illustrating thermit welds for motor cases. Figures are given showing the materials and cost of making ten welds of the largest size. This foots up to $112.90, making the outlay for ten repairs only a little more than the cost of one new motor case.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., closed the year with the best record by a very handsome margin for a year's operation since its incorporation. This was in respect to volume of business and new customers added to its list. The Columbia company is one of the most enterprising and progressive of the big lamp companies in the country.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has ready for distribution its 1908 catalogue descriptive of its alternating-current desk, ceiling and bracket fans. This catalogue is put up in handsome style, and shows a fine line of apparatus for the spring trade. Trade price books on alternating-current fan motors are also ready, and will be furnished promptly upon request.

THE EXCELLO ARC LAMP COMPANY has opened a depot in the Electrical Building, 116-132 Jackson Boulevard, Chicago, Ill., for the convenience of the Western trade. George W. Armstrong, who has been the western traveling representative of the company for the past two years, will be in charge of this branch, and will carry in stock at all times a complete supply of lamps, carbons, globes and all other accessories and parts.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., is sending out a handsome catalogue describing and illustrating some of the important mills which the company has equipped within recent years, not only on the continents of North and South America, but also in the Orient. There are sixty-four pages of excellent halftones and printed matter on heavy paper, and the cover bears a reproduction in color of the Keewatin Flour Mills.

THE ELECTRIC CONTROLLER AND SUPPLY COMPANY, Cleveland, Ohio, has published a very handsome catalogue illustrating and describing its lifting magnets, including not only type S, but a number of other types more suitable for special applications. The magnets are shown in service in typical installations, and a long list of users is given. Upon receipt of information regarding materials and conditions of handling, the company will be pleased to furnish further data.

THE ALBERGER PUMP COMPANY, New York city, has been organized to manufacture and sell centrifugal and turbine pumping machinery embodying novel and important improvements. This apparatus has been designed especially to meet the demand for a high class of work and economical performance. The officers, management and works of the company are identified with those of the Alberger Condenser Company. In order to provide for this business a large addition to the shops is now in progress. The company is prepared to make surveys of plants and to furnish plans, drawings, specifications and estimates, and to contract for centrifugal and turbine pumping machinery for all purposes.

THE GRAEBER-ENTRIKIN MANUFACTURING COMPANY, INCORPORATED, Philadelphia, Pa., has placed on the market two new clock registers for telephones. One of these is a manually operated device which gives a loud signal to the operator and registers on the dials the total number of calls made by the subscriber. The apparatus is compact and neat in appearance, and is permanently fastened to the telephone stand. Only an authorized person will have access to the mechanism. The other register is operated electrically from the telephone exchange, and, like the first, gives a loud signal which is heard by the operator at the exchange and automatically operates the registering dials. The subscriber has no access to the mechanism and simply sees the operation of the dials.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has issued circular No. 1137, describing and illustrating integrating wattmeters for single-phase and polyphase alternating-current circuits and for direct-current circuits. This is a valuable addition to trade literature, as it gives engineering data which are usually confined to engineers' technical text-books, and includes a detailed description of the operating principles and construction employed in the various types of meters. A description is also given of the rolling type ball bearing, together with an explanation of its operation. A practical illustration of a meter's operation is given by likening an integrating wattmeter to a miniature motor-generator set, together with a large number of connection diagrams.

THE LORD ELECTRIC COMPANY, New York city, announces that W. R. Garton, formerly president and treasurer of the W. R. Garton Company, Chicago, Ill., has associated himself with the company and has been appointed general manager of the manufacturing department. Mr. Garton will have headquarters at the general offices, 213 West Fortieth street, New York city. The company has recently made a marked change and improvement in its manufacturing department and is gradually broadening the field of its activity and the scope of this department, having acquired some very valuable patent rights. The company is preparing to manufacture the devices covered by these patents. The Lord Electric Company has been actively engaged in the electrical field, manufacturing and supplying rail bonds, lightning arresters, and kindred devices and appliances. The success attained through the company's efforts in bringing out and developing its specialties has encouraged it to take on additional valuable devices which will appeal to the operator because of their character and their effect upon economy of operation.

Record of Electrical Patents.

Week of January 7.

875,698. ELECTRIC TIME-ALARM. Eduard Dubs, Oerlikon, Zurich, Switzerland. A programme clock.

875,715. INTERCHANGEABLE ELECTRIC DISPLAY APPARATUS. Deronda Levy, New York, N. Y., assignor to Mason Monogram Company, New York, N. Y. An electrical carriage-call.

875,750. CARBON BRUSH FOR COMMUTATORS AND THE METHOD OF PREPARING SAME. Edwin C. Van Nort, Jr., St. Louis, Mo. Ordinary carbon is treated with a boiling liquid containing finely powdered graphite.

875,788. PRESSURE DEVICE FOR ELECTRIC-CURRENT COLLECTORS. Coloman de Kandó, Budapest, Austria-Hungary, assignor, by mesne assignments, to Westinghouse Machine Company. A device for automatically adjusting the pressure of the current-collector on the wire according to the speed of the car.

875,791. CONTROLLER-REGULATOR. John P. Durkin, Philadelphia, Pa., assignor to Durkin Controller Handle Company, Philadelphia, Pa. A device for preventing too rapid movement of the controller.

875,796. LAMP-BASE. Theodore W. Frech, Jr., Cleveland, Ohio. The lamp-base has a projecting skirt coated with fibrous material.

875,801. CONSTRUCTION OF INDUCTION ELECTRIC FURNACES. Gustave Gin, Paris, France. A plurality of receptacles for molten metal having inclined bottoms connected by lateral conduits.

875,803. WIRE SPLICER. George M. Graham, Chicago, Ill., assignor to G. A. Edward Kohler, Chicago, Ill. The wires are threaded through openings in the side of the nut and held in place by the bolt.

875,810. AUTOMATIC FIRE ALARM. Bruce C. Hall and Floyd W. Hall, Elmwood, Ill. A device closing an electric circuit by the melting of fusible metal.

875,830. SOCKET-KEY CLAMP. Max Loewenthal, Newark, N. J. An adjustable clamp for preventing the turning of the key.

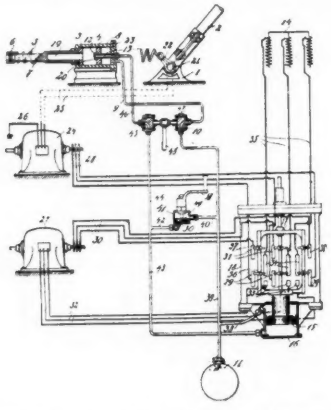
875,833. ELECTRIC ARC LAMP. Joseph A. Meaher, Cleveland, Ohio. The rod holding the carbon passes through the core of the controlling magnet.

875,843. APPARATUS FOR TRACK-CIRCUIT CONTROL. James A. Peabody, Evanston, Ill. A device for impressing reversed-current impulses for signaling purposes on a railway track.

875,872. WIRE CONNECTOR. John J. Walsh, Yonkers, N. Y., assignor to Yonkers Specialty Company, Yonkers, N. Y. A deep-slotted nut.

875,882. DESIGNATION PLUG FOR TELEPHONE SWITCH-BOARDS. Arthur H. Adams, Antwerp, Belgium, assignor to Western Electric Company, Chicago, Ill. A cam on the plug releases the latter when it is turned sideways.

875,900. REVERSING SWITCH. Arthur C. Eastwood, Cleveland, Ohio. A segmental rotatable switch.



875,788.—Pressure Device for Electric-Current Collectors.

875,901. SYSTEM OF CONTROL FOR ELECTRIC MOTORS. Arthur C. Eastwood, Cleveland, Ohio. The motor is given a higher speed prior to deenergizing the closing mechanism of a switch giving a lower speed.

875,902. MEANS FOR INSULATING THE SUPPORTS OF ELECTRIC CONDUITS. Carl E. Egnér, Stockholm, Sweden. Conical woven caps for placing over insulator pins.

875,910. ELECTRIC CHAIN-WELDING MACHINE. Hugo Helberger, Munich, Germany. A resistance-welding machine with pivotally mounted jaws.

875,911. SAFETY-SIGNAL SYSTEM FOR RAILWAYS. William F. Herting and Frank C. Chlan, Baltimore, Md. An electrical system for placing signaling torpedoes on the track.

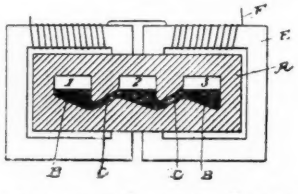
875,978. ELECTRIC SWITCH. Frank G. Baum, San Francisco, Cal. The contact jaws are carried on large insulators, connection being made by swiveling arms similarly supported.

875,981. MOTOR-CONTROLLING MECHANISM. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. A device for regulating the resistance in the rotor circuit of an induction motor.

875,982. MOTOR-CONTROLLING MECHANISM. Herbert W. Cheney, Norwood, Ohio, assignor to Allis-Chalmers Company and the Bullock Electric Manufacturing Company. An arrangement for short-circuiting internally the rotor of an induction motor.

876,036. ELECTRICALLY CONTROLLED RELEASING DEVICE. Ralph P. Barnes, Schenectady, N. Y. A door release.

876,055. SWITCH. Carl H. Holley, Visalia, Cal., assignor of one-half to Fred G. Hamilton, Visalia, Cal. A plunger oil switch.



875,801.—Construction of Induction Electric Furnaces.

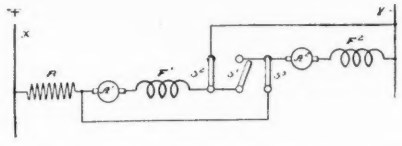
876,064. SINGLE-TRACK SIGNALING AND TRAIN-CONTROLLING SYSTEM FOR RAILWAYS. Frank E. Kinsman, Plainfield, N. J. A system enabling the power to be cut off or the brakes to be set on any train.

876,165. WIRELESS-TELEGRAPH TRANSMITTING SYSTEM. Lee de Forest, New York, N. Y., assignor to George K. Woodworth, Boston, Mass. A transmitting-loop antenna forming a closed oscillating circuit.

876,169. RECEPTACLE FOR INCANDESCENT LAMPS. Gilbert W. Goodridge, Bridgeport, Ct., assignor to Bryant Electric Company, Bridgeport, Ct. A sign receptacle with laterally projecting lugs.

876,187. JUNCTION BOX. Harry H. Hornsby, New York, N. Y. Integral outwardly turned ears are provided at the upper edge of the box.

876,192. SIGNAL-ALARM SYSTEM. Oliver B. Kaiser, Norwood, Ohio, assignor of one-fourth to Walter S. Ludlow and one-fourth to Walter S. Ludlow, Jr. A fire-alarm and extinguishing system.

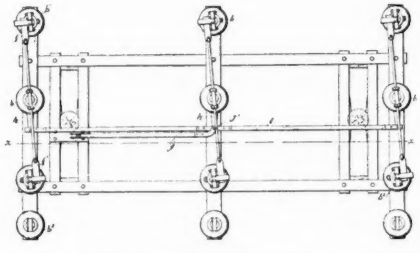


875,901.—System of Control for Electric Motors.

876,203. IGNITION-CIRCUIT CONNECTION. Edwin S. Lincoln, Brookline, Mass. A generator and secondary battery may be used individually or at the same time.

876,207. PUSH-BUTTON ELECTRIC SWITCH. William G. Mann, Bridgeport, Ct., assignor to the Perkins Electric Switch Manufacturing Company, Bridgeport, Ct. Contacts for more than one circuit are provided.

876,233. ELECTRIC-LAMP RECEPTACLE. Herbert E. Plass, Newark, N. J., assignor to Howard Miniature Lamp Company, Newark, N. J. The body of the receptacle is made in three parts.

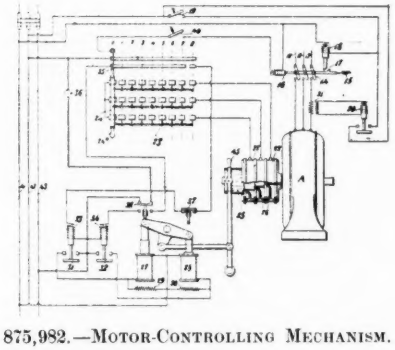


875,978.—Electric Switch.

876,273. FUSE DEVICE. Frank B. Hall, Wheeling, W. Va. A supporting member is provided for the fuse.

876,274. ELECTRICALLY CONTROLLED RELEASING DEVICE. Charles J. Kintner, New York, N. Y. Valves for a railway signal operated by gas or liquid are controlled electrically.

876,281. COMBINATION SENDING AND RECEIVING WIRELESS-TELEGRAPH APPARATUS. Albert L. New, Los Angeles, and William N. Hickman, Avalon, Cal.; said Hickman assignor of one-half of his right to said New. A system in which the strength of the impulse may be regulated and an indicator which automatically shows the range of each strength of impulse.



875,982.—Motor-Controlling Mechanism.

876,293. ELECTRIC TIME SWITCH. Frank W. Brock, Chatham, Ill. Two independent switch levers are provided, one for closing and the other for opening the circuit.

876,312 QUADRUPLEX OR MULTIPLEX TELEGRAPHY. Lawrence Connell, Jr., Portland, Ore. A system utilizing a neutral relay having an armature and two main energizing coils, one consisting of differentially disposed high-resistance windings and the other of differentially disposed low-resistance windings.